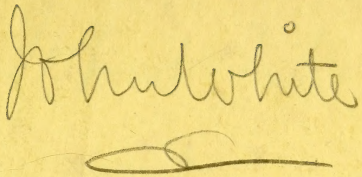
Ocean Gardens

Glimpses Beneath the Waters



John White —

Seaford

Plate V.

1. Laurencia pinnatifolia.
2. Polysphonia parasitica.
3. Ulva latissima.
4. Rhodymenia lacinata.
5. Gracilaria confervoides.
6. Codium bursa.
7. Iridæa edulis.
8. Zonaria parvula.
9. Ectocarpus tomentosus.
10. Corallina officinalis.

OCEAN GARDENS:

The History of the Marine Aquarium,

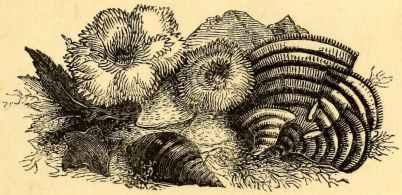
AND

THE BEST METHODS NOW ADOPTED FOR ITS ESTABLISHMENT AND PRESERVATION.

BY

H. NOEL HUMPHREYS,

AUTHOR OF "BRITISH BUTTERFLIES AND THEIR TRANSFORMATIONS;"
"BRITISH MOTHS AND THEIR TRANSFORMATIONS;"
"INSECT CHANGES;" ETC.



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CONTENTS.

CHAPTER VII.

CHAPTER VIII.

CHAPTER IX.

LIST OF PLATES.

PLATE I.

SEA-WEEDS.

PLATE II.

SEA-WEEDS.

PLATE III.

PLATE IV.

SEA-WEEDS.

PLATE V.

SEA-WEEDS.

PLATE VI.

SEA-ANEMONES, STAR-FISH, ETC.

PLATE VII.

PLATE VIII.

PLATE IX.

PLATE X.

PLATE XI.

PLATE XII.

OCEAN GARDENS;

OR,

GLIMPSES BENEATH THE WATERS.

CHAPTER I.

INTRODUCTION.

WHAT the vast majority of our migratory flocks of summer and autumnal idlers generally do and think at the sea-side, cannot be better exemplified than by reference to the clever sketches which are found occupying entire pages of our illustrated periodicals and newspapers, during the season of marine migration. But the habits and customs of the annual shoal of visitors to our watering-places, may be still more intimately comprehended through the medium of the sprightly essays which generally accompany those truly artistic delineations.

And is there really nothing better to do—no

better *regime* to go through, than the daily repetition of the monotonous programme of entertainment thus playfully described and ridiculed?

Surely the visitor at the sea-side is in reach of something more pleasant and profitable than such a routine!

Do not the sublime aspects of the ocean—the sound of its deep, ceaseless voice—the eternal oncoming of its waves, now in calm undulations, and now in hurtling wildness against the base of those cliffs whose white brows are wreathed with perennial flowers—suggest other matters both for reflection and amusement? Surely the very whispering of the breeze that has travelled so far over that vast moving surface of the fathomless deep, and which seems muttering of its mysteries, while laden with its sweet saline odour—"*ce parfum acre de la mer*," as Dumas has termed it—might lead us towards other and higher trains of thought. Surely those voices in the wind, mingling with the strange murmur of the waves as they break in cadenced regularity upon the shore, rouse, in the feelings of those who hear them for the first time, or after a long absence, strange sensations of admiration, and curiosity, and wonder. But no; to most of the idle crowd those sights and sounds are invisible and

unheard. Their ears have not been tutored to understand the word-music of Nature's language, nor to read the brightly-written signs on its mighty page.

To appreciate Nature, as well as Art, the mind requires a special education, without which the eye and the ear perceive but little of the miracles passing before them. To the eye of the common observer, the farthest field in the landscape is as green as the nearest, in the scene outspread before him; while to the practised glance of the accomplished artist, every yard of distance lends its new tone of colour to the tints of the herbage, till, through a thousand delicate gradations, the brightest verdure at last mingles with the atmospheric hue, and is eventually lost in the pervading azure. If, then, the ordinary aspects of Nature may not be fully interpreted by the untutored eye, how should her more hidden mysteries be felt or understood, or even guessed at? And, in fact, they are not, or the visitor to the sea-side, looking over that wide tremulous expanse of water that covers so many mysteries, would feel, like the child taken for the first time within the walls of a theatre, an intense anxiety to raise the dark-green curtain which conceals the scene of fairy wonders he is greedily longing to

behold and enjoy. But the lounger at the sea-side does not guess at the wonders concealed by the dark-green curtain of the ocean, and, consequently, never dreams of wishing to peep beneath its waving folds, to gratify a curiosity which, in fact, does not exist.

When, however, the language of Nature is learnt, and her voice is no longer a confused murmur to the ear, but becomes a brilliant series of eloquent words, full of deep and exquisite meaning, then the student will *see* as well as *hear;* but till then, in his intercourse with Nature, he is both deaf and blind. "Speak," said Socrates to a youth; "say something, that I may *see* you." Socrates saw not a silent man; and those who do not hear and understand Nature's language, cannot see her wondrous beauty.

The mill-like repetition of worldly affairs brings on a torpor of mind, in regard to all without the narrow circle of selfish interests and easily purchased pleasures, which it is very difficult to wake up from. But I would warn the suffering victims of that baneful, though secret, presence; for when the consciousness of its existence is aroused, the first step will have been taken towards its eradication.

I would remind all those suffering from inactivity of mind, of the wholesome dread of that kind of mental torpor entertained by the Gymnosophists; who, as Apuleus tells us, when they met at meals, required that each should be able to narrate the particulars of some discovery, or original thought, or good action, or it was deemed that he did not exhibit a sufficient reason for being allowed to consume a share of the viands, and he was consequently excluded from the repast. Were each of our most idle sea-side loungers to impose upon himself the necessity of a discovery, or an original thought, before he considered himself entitled to dine, that torpor, so deadening to the natural capacities of his mind, would soon give way to a state of mental activity, which, were it only from the brightness of the contrast, would be found highly agreeable, to say nothing of its advantages, or of the elevating and refining trains of thought to which it would necessarily give rise.

I know of nothing more likely to stimulate the mind to healthy exertion, and take it out of the immediate track of common interests and pleasures, the monotony of which is so oppressive, than the study of natural history in some of its least explored fields, especially its extraordinary development in

connection with the waters of the ocean. And yet, how few there are who seek that charming mode of dissipating the dreary monotony of social life, such as it is made by the routine of fashion or habit! A popular love of natural history, even in its best known divisions, is, in fact, of quite recent growth. Indeed, the very existence of such a science has been, till recently, altogether ignored by our great national seats of learning. The earnest investigators, who have done so much to lay bare its wonders, were either openly ridiculed, or treated with but small respect—as useless dreamers upon very small and insignificant matters. The very names of such true labourers in the mine of science as our glorious old naturalist Ray, or his follower Pulteney, or the indefatigable Ellis, the first detector of the true nature of Zoöphytes, who measured pens with the giant Linnæus, received no academic honour; and those of their undiscouraged successors have been rarely heard, either in our universities or among our general public, till the vast discoveries of geology and other allied branches of science, in our own times, have at last aroused attention to their importance.

Any popular knowledge of that branch of natural history which especially concerns our seas and

shores, is indeed of still more recent date. The subject, in fact, is but even now beginning to develop itself beneath the pens of an enterprising band of marine naturalists, with such leaders as Johnston, Harvey, John Edward Gray, the indefatigable Gosse, and the revered shade of the lamented Forbes at their head.

A truly popular knowledge even of those more accessible regions of our woods and fields, is but little more ancient; for, till Gilbert White had made the story of such knowledge as attractive as romance, in his "Natural History of Selborne," few guessed what an arena of ever new interests and discoveries it presented.

Through the fascinating interpretation of the good Gilbert, many now understand the attraction of those branches of natural history which he so curiously investigated; but few are willing to admit that it is as easy to make the natural features of some obscure fishing-village, with no herbage on its bare rocks, and no bush, no blade of grass, no bird to be seen or heard, equally interesting; yet I can assure them, that by lifting even the mere border of that green curtain of the ocean, or by awaiting its unveilings, as the retiring tide bears back its folds, a host of wonders will be revealed, sufficient to rouse the

most torpid mind of the most inactive idler to their earnest and deeply-inquiring contemplation, and arouse him to their devout admiration, as among the most exquisite miracles of that creative and sustaining Power which is the source of their existence.

CHAPTER II.

THE FLOOR OF THE OCEAN.

THE wonders of the ocean floor do not reveal themselves to vulgar eyes. As the oracle was inaudible to sacrilegious listeners, and as none but poetic ears heard the cadenced beating of the feet that danced to unearthly music, near the fountain haunted by the Muses of classic fable—so, none but the initiated can see the myriad miracles that each receding tide reveals on the ocean floor. The initiation, however, is not mysterious; there are no dark rites to observe—no Herculean labours to accomplish, before entering upon the noviciate, which at once opens a large area of unexpected pleasures, and an ample field for admiration and investigation. A few elementary works carefully studied, or even this present little book attentively perused, would supply the first helps towards *seeing*, at all events, a portion of the "wonders of the shore," as the brilliant author of "Glaucus" has eloquently termed those revelations of the retiring deep.

It is the *seeing* that is everything. But let none

despair of acquiring that power. "The name of the Devonshire squire, Colonel George Montague" (thus wrote the late Professor Edward Forbes), "might have become one of the greatest in the whole range of British science, had his whole career been devoted to marine physiology;" and that mainly because, from a sincere devotion to a favourite pursuit of his leisure, he acquired the art of *seeing*—an art sought by so few, though open to all who will earnestly seek it.

Each department of science requires a separate and distinct kind of sight. The astute merchant deciphers at a glance the precise state of the most intricate accounts, in the midst of thousands of seemingly conflicting figures; but of the thousand interesting and wonderful things concerning the little beetle that crosses his path in his country walk, he is incapable of seeing any single particle; while the despised entomologist, whom he has contemptuously observed turning over the stones at the road-side, and peering curiously beneath them, could tell him a tale of wonder, could preach him a sermon upon that tiny type, such as would surely wake up many latent and unsuspected powers in his mind, that would enable him to *see* wonders where all had previously been blank, and teach him that

there are things well worthy of investigation beyond the region of money-making, and the attractive but narrow circle distinguished by the fascinating characters, £ *s.* *d.*

Those who cannot *see* Nature, who cannot see more than an unclean thing in the little creeping beetle, are like one gazing at a carved Egyptian record, who perceives, in the hieroglyphic scarabæus, simply the sculptured figure of a beetle, and no more—they are in a state of "Egyptian darkness" as regards one of the highest and most enchanting fields of human research. But to those who have acquired this rare though easy art, and learned to *see* Nature, even to a moderate extent (for in that art are an infinite number of degrees and gradations), the aspect of the ocean floor must present an appearance as beautiful and strange, and seemingly as supernatural, as the wildest imagination could depicture.

When poets would travel, in their inventive flights, to other floating and revolving worlds than ours, they describe rosy skies, instead of azure, and trees like branching crystals, with jewel-like fruits glittering on every stem. They present us with pictures, in short, in which all the ordinary aspects of our planet are reversed, or metamorphosed, in the region of their invention; but in their most fanciful

pictures they do not surpass in strangeness the wonders of the world beneath the sea.

On the land, we have, as the ordinary aspect of Nature, the green herbaceous mantle of the earth below the eye, and the azure sky above; while a spectator, standing beneath the water on the ocean floor, would see these features more than reversed: he would see above him a liquid atmosphere of green, and below, an herbage of red or of purple hue, exhibiting strange yet exquisite forms, such as no terrestrial vegetation displays. Roseate shrubs of jointed stone, and arborets of filmy glass, and creatures full of active, energetic life, whose forms are stranger still, both in structure and in appearance; mere worms, whose colours are gorgeous as the tints of the butterfly's wing, or the peacock's tail, or the humming-bird's breast.

What scenery is formed by that translucent and miniature forest of *Delesseria sanguinea*, how lovely in its tones of soft rich crimson; and those fan-like shrubs, in crisply graceful tufts, the bright and singular *Padina pavonia;* and the tree-like masses of *Callithamnion arbuscula*, and the delicate *Ptilota plumosa*, and the purple-tinted *Corallines*, forming those

"Arborets of jointed stone."

And then the high waving fronds of the grandly

graceful *Porphyra vulgaris*, the deep carmine of the *Iridæa edulis*, the nacreous tinges of the *Chondrus crispus*, and the blood-red of the splendid *Rhodymenia lacinata*, with its embroidered and lace-like edges; these, with the gorgeous tufts of the rich purple *Bangia*, and other objects which form the elements of still life in a submarine landscape, surely cannot be surpassed, either for magnificence of colour or variety of structure.

But to these features must be added others more extraordinary—forms that the elder naturalists imagined to be links between the animal and vegetable creation, but which are now known to have no affinity whatever with plants, though they exhibit the appearance of expanded flowers of various hues, displaying the forms of the Carnation, the Anemone, the Mesembryanthemum, and other beautiful flowers whose names they bear. These curiously beautiful Zoöphytes, the wonderful *Actiniæ*, exhibit every tone of colour, from purple and scarlet, to green and white, and might be taken in their picturesquely-placed groups for rare exotic flowers, planted among the rosy-tinted shrubs expressly to add the last touch of richness and effect to the scenery of an ocean flower-show.

Yet they are not flowers, but animals—sea

monsters, whose seeming delicate petals are but their thousand Briarean arms, disguised as the petals of a flower, and expanded to seize the unconscious victim as he passes near the beautiful form—fatal to him as the crater of a volcano; in which he is soon engulphed by the closing tentacles of his unsuspected enemy. And if he pass not near enough for that deadly floral embrace, those pretty crimson tubercles that dot so gracefully the seeming stalk, beneath the seeming flower, can shoot forth a thread, armed, like the fisher's line, with a barbed hook, which strikes and secures the distant prey; and so the unwary *Annelid* or *Infusory* is captured and devoured. In this capacity the creature has been compared to Pope's spider, who

"Feels at each thread, and lives along the line."

But then the living thread of the *Actinia* (or of the *Cirriped*, which has a similar power) is a fact, while the sensitive gossamer of the poet is a fiction.

But notwithstanding these ogre-like attributes, the lovely *Actinia* long deceived our naturalists as to its true nature—and of course the poets—from whom his flower-like disc and petaloid tentacles completely concealed his grosser nature. Then, as the tide recedes, he so meekly closes his beautiful

oubliette, with so much grace, and looking so much like those shrinking flowers that close at eve, as though they dared not to look on the black darkness of the night, that it is no wonder poets were beguiled, and that the romantic Southey sings of the *Actinia* as of some lily of the deep that, on the retiring of the ocean,

"Sinks down within its purple stem to sleep."

To add to the wonders of this strange landscape come the creeping *Nudibranchs* and *Tectibranchs*, gliding over the gracefully-waving *Algæ;* their elegant forms decorated with their external breathing apparatus, like the pale skeleton of some delicate flower, so fine are its milk-white filaments, arranged nearly always in a symmetrical and star-like form. And then there are the singular and shadowy *Medusæ* floating past, in the form of parachutes, with low suspended cars, just as though the science of ballooning had been carried to perfection under the sea; and that they were made of elastic glass, instead of silk, though richly flushed with iridescent and varying tinges, sometimes metallic azure, and anon emerald green; hues that seem added by some delicate process which the glass-blowers above the water have not yet discovered. Some of these creatures are fragile as a

soap-bubble, to which their transparency and prismatic flashes of colour give them a curious resemblance; and their ephemeral existence, dependent upon the will of even an angry ripple of the element in which they live, is doubtless as brief.

The deep has even its butterflies, as well as the land. The fluttering of the fins of some small and brightly-coloured fish has been compared to the action of the wings of moths—as also the members, likewise used for locomotive purposes, of some of the animals of the univalve shells. Then there are minute phosphorescent animals, which represent the fire-flies of the south, pouring a living flood of light as they glide along — some emitting silvery, and others golden flashes, like floating lamps that seem hurrying to light up the darkness of the far ocean depths.

Even the worms are gorgeous and wonderful in this subaqueous world. The *Serpulæ*, with their radiating coronets of crimson *branchiæ;* the *Pectinaria*, with its golden comb, glittering in burnished brightness; and the *Nereis*, with white and crimson stripes—are all wonderful as well as beautiful objects. But the *Halithea*, or sea-goddess, as Lamark has named it, from the extraordinary beauty and the georgeous colours that radiate from the silky hairs with which it is clothed, surpasses them all.

These, and other wonders of still greater beauty, will reward the persevering student who learns to *see* them; but then he *must* learn. Even the intellectual giant, Shakspeare, could not see clearly many of the minuter things of Nature. In his line upon the slow-worm, for instance, vulgarly called the blind-worm, which he describes as

"The eyeless, venomed worm,"

are concentrated two mistakes; in the first place, the minute eyes of this little creature are brilliant in the extreme, and not very difficult to discover, to the naturalist who has learnt to see nature; and, in the second place, it has no venom, its tiny bite being perfectly harmless. In another place he speaks of

"The blind-worm's *sting*."

But it is useless to multiply examples of the physiological errors of great men who had not learned to *see* Nature; or, Milton's errors in regard to the leaf of the Banyan-tree, and many others, might be readily cited.

There are many glorious things to be seen in the sea, but we have to learn to *see* them; and those who find they cannot see with their own eyes, must do so through the more gifted sense of others. To many—how many, unguided by an able Cicerone—the fields

round Selborne would appear common and uninteresting enough; but guided by a Gilbert White, whose searching eye knew even the hidden forms of plants, whose ear at once distinguished and classified the song of birds, and even the buzz of insects—guided by him, things assume a far different aspect; like another Prospero, he waves his wand, and every object begins to brighten, and a thousand new and beautiful features develop themselves under the magic of his descriptions; crowds of marvels springing up around, as from enchanted ground. In like manner, guided by the fascinating science of a Johnston or a Harvey, or the persuasive industry of a Gosse, or the eloquently glowing descriptions of a Kingsley, students, who have not the energy or leisure to work for themselves, will find the dark ocean glow with an unexpected light; and the delighted explorer will long for the power to renew the impressions of his sea-side rambles after his return to his inland home, perhaps in the heart of a densely-populated city. Even this he may now do through the medium of the marine Aquarium, within the narrow boundaries of which he may, with a little care and experience, establish in healthy existence some of the most beautiful of the animal and vegetable forms that people the caves and depths of the ocean, and make its watery world a region of wonders.

CHAPTER III.

THE AQUARIUM.

The successful treatment of aquatic plants and animals, in the confined space of a glass Aquarium, depends entirely upon the discovery that there exists in Nature a self-adjusting balance between the supply of oxygen created in water, with the quantity consumed by aquatic animals. And it became equally necessary to know the means by which that supply was continually generated. Without the knowledge of these facts, and the principles by which they are regulated, it would have been impossible to establish such a marine Aquarium as that we may now any day examine in the Regent's Park; where, in a few glass tanks of very moderate size, we may see examples of some of the most curious forms of animal and vegetable life peculiar to the depths of the ocean—forms so singular, that their first exhibition created a sense of wonder little less intense than that which must have been caused, long years ago, by the first public display of the mountain form of the elephant to the

people of cold northern countries; and much more so than the recent introduction of the giraffe or hippopotamus, although they have never been seen in Europe since the days of the Romans.

Those principles, the knowledge of which was requisite to enable us thus to view the wonders of the ocean in their living state in an Aquarium, were not mastered at once, or by one man, or in one generation. The nature of certain relations between animal and vegetable life, upon which they are founded, was first advanced by Priestley, towards the close of the last century, who proved that plants give forth the oxygen necessary to animal life. The learned Ingenhauss, a native of Breda, but who principally resided in England, defined this principle still more clearly, in a work the title of which pretty fully explains the entire nature of his discovery. It was published in French, at Leyden, in 1778, and in London, in English, in 1779. The French edition is before me, the title of which I translate, "Experiments upon Plants, which prove their important influence in the purification of the atmospheric air when they are exposed to the rays of the sun, and the contrary results which ensue when they are placed in the shade, or during the night." The action of the sun's rays in disengaging

the oxygen generated in plants is thus clearly announced, and the knowledge of this principle is one of those which have mainly conduced, as I have said, to the successful establishment of Aquaria.

In the course of his essay Ingenhauss states, still more directly, that plants "immersed in water," when exposed to the action of light, emit an air which he announces as oxygen gas; and this idea is the key-stone of the Aquarium.

But, although the discovery of Ingenhauss at once rendered the thing practicable, Aquaria did not then come into fashion. The science of natural history was not at that time sufficiently advanced; for the specimens, even in public museums, were merely heterogeneous collections, assembled without the slightest regard to classification, or any other useful purpose. A stuffed cat with nine legs, stood, perhaps, next to a bottled snake, followed by the skin of a crocodile, to be succeeded in turn by a very moth-eaten specimen of a King Charles spaniel, "supposed, upon good authority, to have belonged to Nell Gwynne." A few scores of such objects, with the addition of an ostrich egg and a few sea-shells, without any attempt at name or description, formed a very respectable museum in those times; and we may, therefore, easily conceive

that (in so far as experiments illustrative of natural science were concerned) the suggestions of Ingenhauss remained tolerably dormant.

It was not till the year 1833, that Professor Daubeny communicated, to the British Association at Cambridge, a paper concerning some new researches prosecuted in the same direction; and not till 1837, that Mr. Ward became the first to apply the principle to any purpose analogous to that of the Aquarium. In that year he made a report to the British Association, on the hermetically closed glass cases in which he had succeeded in growing many classes of plants, and keeping them in a healthy state without any fresh supply of air. He stated, at the same time, his belief that certain classes of animals would live and thrive under similar circumstances. This was the first direct hint towards the formation of a closed Vivarium, whether atmospheric or aquatic.

In 1842, Dr. Johnston satisfactorily proved the true vegetable nature of *Corallines* by observing their growth in a vessel containing sea-water; and thus was established the first true Aquarium. With the experimental tuft of *Coralline* was a small frond of a green *Ulva*, and numerous *Rissoæ*, &c., and several *Annelids* afterwards appeared, having been,

no doubt, attached to the branches of the *Coralline*, or the fronds of the *Ulva*. At the end of four weeks the water was still pure, the Molluscs and other animals alive, and the Confervæ grown; the *Coralline* having thrown out several additional articulations. After eight weeks, the water still remained sweet. But had any animal, of even the lowest order, been so confined, without the accompanying presence of vegetables giving off oxygen, all of that vital gas contained in so small a quantity of water would have been quickly exhausted, and the water would have become corrupt, ammoniacal, and poisonous to the life of any living thing. But the author of this experiment had not in view the testing of the possibility of preserving the forms of ocean life in a healthy state in confinement; his business had been to settle an important point connected with the classification of the *Corallines;* and having successfully decided that question, the embryo Aquarium was abandoned.

On the 4th of June, 1850, Mr. R. Warrington communicated to the Chemical Society a series of observations on the adjustment of certain relations between the animal and vegetable kingdoms, very important to our present purpose. Two small goldfish were placed in a glass receiver, a small plant of

Valisneria spiralis being planted at the same time in some earth, beneath a layer of sand in the same vessel. All went on well by this arrangement, without any necessity for changing the water; the oxygen given off by the plant proving itself sufficient for the supply of its animal co-tenants, and the water therefore remaining clean and pure, until some decaying leaves of the *Valisneria* caused turbidity, and confervoid growth began to accumulate on the sides of the vessel. To remedy this evil, Mr. Warrington brought to bear the results of previous observations on water in natural ponds under analogous circumstances; and, guided by these observations and their results, he placed a few common pond-snails in the vessel containing his gold-fish and plant of *Valisneria*.

The new inmates, immediately upon their introduction, began to feed greedily upon the decaying vegetable matter, and all was quickly restored to a healthy state. They proved, indeed, of still further advantage, for the masses of eggs which they deposited evidently presented a kind of food natural to the fishes, which was eagerly devoured by them, so that the snails became not only the scavengers, but also the feeders of the little colony. And so this first of true Aquaria prospered; the animals and

plants proving of mutual value and support to each other. The snails disposed of the decaying leaves, which would have tainted the water and rendered it unfit for the healthy existence of the plant, and the plant in turn gave forth, under the rays of sunlight, the supply of oxygen necessary to both fish and snails.

In January, 1852, Mr. Warrington, commenced a series of similar experiments with sea-water; which were, at first, not so satisfactory, but in the end proved as entirely successful. In the course of his experiments, he found the red and brown *Algæ*, or sea-weed, less proper for the formation of oxygen than the green. Of the latter class he procured specimens of *Enteromorpha* and *Ulva latissima*, which he chiselled from the rocks about Broadstairs, along with the pieces of chalk or flint to which they were attached; and, when he placed them in his own marine Aquarium, he put in along with them, to represent the pond-snails in the fresh-water tank, some of the common sea-snail, better known as the Periwinkle (*Littorina littorea*). But these proved, it appears, insufficient for the destruction of the mucous and gelatinous matter that arose from the decay of the red sea-weeds, which, however, I have no doubt may yet be cultivated with

equal success with the green, as I shall state when describing them. Under the existing difficulty, Mr. Warrington found it necessary to aerate the water by other means, many processes being equally available; such as injecting fresh-water from a syringe, or establishing a drip, of some height, from a vessel containing a supply of entirely fresh-water. Mr. Warrington also discovered, in the course of these experiments, the necessity that the light should pass directly through the surface of the water to the plants, as in natural ponds and seas—a very important step in the successful management of Aquaria; and he therefore had a slab of slate adjusted to the side of his tank which stood next to the light.

These successful experiments, both in fresh-water and marine Aquaria, assign to Mr. Warrington, beyond dispute, the credit of being the originator, or inventor, if the term may be so used, of these charming additions to our conservatories, corridors, and even living-rooms, to which they are certainly a much more attractive and instructive addition than the old globe of blank water, with its pair of gold-fish swimming round and round in ceaseless gyrations, tiresome to behold, in the vain hope of escaping from their glaring and inconvenient prison;

in which they would inevitably have perished very shortly but for the daily change of water, which, previous to our knowledge of air-emitting plants and their use, was absolutely necessary.

But another experimentalist was now in the field. Mr. Gosse, whose charming works upon Aquaria and other subjects connected with natural science, have, perhaps, made his name more widely known than that of his predecessor, Mr. Warrington, commenced a series of experiments on the subject of the marine Aquarium, about the same time as the last-named gentleman, in the beginning of January, 1852. His experiments were crowned with such complete success that he was induced to put himself in communication with Mr. David Mitchell, the enterprising Secretary of the Zoological Society, the result of which was the removal of the collection of *Annelids* and *Zoöphytes* which Mr. Gosse had formed, to the gardens of the Society in the Regent's Park; where it formed the nucleus from which has grown the magnificent series of Aquaria in the building constructed specially for their reception. These marine Aquaria at once became a subject of public as well as private interest, and the Aquarium house was so crowded daily with its curious visitors, that it was difficult to get a glimpse of the

wonders of the "ocean floor," and its zoöphytic denizens, which were so successfully exhibited there; principally through the skilful aid and untiring industry of Mr. Gosse, through whose hands above five thousand specimens passed at the time, collected at the request of the Zoological Society.

In his interesting record of his early essays, Mr. Gosse gives us many valuable particulars concerning his successive experiments, and the various disappointments to which he was at first subjected; many of them from causes now too well understood to require repetition. His principal difficulty arose from over-crowding, although his tank did not appear, as he states, too much filled. Another disappointment was caused by putting in animals before the smell of the putty, with which the glass sides were fixed, had sufficiently gone off.

Mr. Gosse's tank was made with a slate bottom, and birch pillars, in which were grooves to receive the glass; and its dimensions were, two feet long by one foot six wide, the depth not being mentioned.

Taking these dimensions into consideration, it will be easy to conceive, when the following list of specimens which Mr. Gosse introduced into his Aquarium is examined, that his population was too dense for the extent of his province, although the

space might not have appeared too much filled for picturesque effect. Of vegetable specimens, he introduced at once the following:—

1. A tuft of *Furcellaria fastigiata.*
2. Two of *Rhodymenia palmata.*
3. One of *Dictyota dichotoma.*
4. A small *Fucus serratus.*
5. One *Laminaria digitata.*
6. Two tufts of *Padina pavonia.*
7. Several masses of *Corallina officinalis.*
8. *Griffithsia setacea.*
9. *Delesseria alata.*
10. *Plocamium coccineum.*
11. *Phylophora rubens.*
12. *Zostera marina.*

In a few days the water, poured carefully to these specimens, became clear as pale green crystal, the green tinge being too slight to obscure the colour of any object seen through its medium.

From these weeds alone, before any supply of Zoöphytes or Molluscs were intentionally added, a whole host of minute animal life swarmed forth; some, doubtless, issuing from eggs newly hatched; others from the shelter of the matted ramifications of some of the sea-weeds, in which they had been taken, as in a net. Among these swarming creatures were Annelids of the genus *Syllis*, *Rissoæ*, and other minute shell-fish, but principally *Isopodous* and *Entomostracous Crustacea*, many of them being so minute as not to be perceived without the use of a powerful lens.

Of the animals next placed in this tank, of only two feet by one foot six inches, the following is the list given :—

FISH.

1. Fifteen, Spined Stickleback . . . *Gasterosteus spinachia.*
2. Seven, Gray Mullet (young) . . . *Mugil capito.*
3. One, Black Goby . . . . . *Gobious niger.*
4. One, Corkwing . . . . . *Crenilabrus cornubicus.*
5. One, Five-bearded Rockling . . . *Motella 5-cirrata.*
6. One, Great Pipe-fish (young) . . . *Syngnathus acus.*
7. One, Worm Pipe . . . . . *Syngnathus lumbriformis.*

SHELLS, MOLLUSCS, ETC.

1. Two, Ashy Top . . . . . *Trochus cinerarius.*
2. One, Navel Top . . . . . *Trochus umbilicatus.*
3. Three, Common Periwinkle . . . . *Littorina littorea.*
4. Three, Yellow Periwinkle . . . . *Littorina littoralis.*
5. One, Purple . . . . . *Purpura lapillus.*
6. One, Scrobicularia.
7. One, Anomia.
8. Two, Common Cockle . . . . . *Cardium edule.*
9. Two, Ascidia.

CRUSTACEA, ETC.

1. Two, Hermit Crab . . . . . *Pagurus Bernhardus.*
2. One, ditto . . . . . *Pagurus Prideauxii.*
3. Four, Sand Shrimp . . . . . *Cragnon vulgaris.*
4. One, Prawn . . . . . *Palæmon serratus.*
5. Three, Crown Worm . . . . . *Serpula triquetra.*
6. Three, White-line Worm . . . . *Nereis bilineata.*

ZOÖPHYTES.

1. Two, Thick-horned Anemone . . . *Actinia crassicornis.*

2. Three, Weymouth Anemone . . . *Actinia clavata.*
3. Two, Parasitic Anemone . . . . *Actinia parasitica.*
4. Six, Plumose Anemone . . . . . *Actinia dianthus.*
5. Five, Daisy Anemone . . . . . *Actinia bellis.*

There were thus above seventy specimens, animal and vegetable, already in the tank, without counting the swarms of smaller creatures, some the young of large species, daily increasing in size; yet, our bold experimentalist, anxious to conquer his "Russia" at one grand invasion, still poured in fresh specimens. These consisted of:—

FISH.

1. One, Æquorial Pipe-fish. . . . . *Syngnathus æquoreus.*

MOLLUSCS, CRUSTACEANS, ETC.

1. One, Rough Doris . . . . . *Doris pilosa.*
2. Two, Magus Top . . . . . *Trochus magus.*
3. One, Nerit . . . . . *Natica Alderi.*
4. One, Squin . . . . . *Pecten opercularis.*
5. One, Pholas . . . . . *Pholas parvæ.*
6. One, Pisa . . . . . *Pisa tetraodon.*
7. One, Cleanser Crab . . . . . *Portunus depurator.*
8. One, Ebalia . . . . . *Ebalia Pennantii.*
9. One, Hermit (small) . . . . . *Pagurus* . . . . . .
10. Three, Lobster Prawn . . . . . *Athanas nilescens.*

STAR-FISH, ETC.

1. One, Brittle Star . . . . . *Ophiocoma rosula.*
2. One, Eyed Cribella . . . . . *Cribella oculata.*
3. Two, Scarlet Sun-Star . . . . . *Solaster papposa.*

4. One Bird's-foot Star . . . . . *Palmipes membranaceus.*
5. Three, Gibbous Starlet . . . . . *Asterina gibbosa.*
6. One, Purple-tipped Urchin . . . . *Echinus miliaris.*
7. Seven, Scarlet Madrepore . . . . *Balanophillia regia.*
8. Three, Cloak Anemone . . . . . *Adamsia palliata.*

These additions brought the collection up to above a hundred specimens, and no doubt the tank made a glorious show; but Mr. Gosse, though the Napoleon of his specialty, was forced to acknowledge that there was an "impossible." Although his collection was superb, and his interesting tank did not look over-crowded, yet he soon discovered that a forbidden limit had been passed, and that the creatures of the ocean that have yards—fathoms—of their native element to their own separate share, cannot accommodate themselves to the allotment system, in the proportion of a square inch to each individual.

To remedy this state of things, the evil effects of which soon became apparent, artificial aeration was resorted to, by means of another vessel, which kept up a continuous supply of dripping fresh water. But even this assistance did not enable the crowded colony to exist more than ten days. In the first place, there were many predatory species, which destroyed their associates; these kinds must, therefore, be excluded from an Aquarium, or kept in a

Plate XI.

A DESIGN FOR A PLAINLY-MOUNTED AQUARIUM.

separate tank. But, after all, the impossibility of providing a sufficient supply of oxygen was evidently the great and principal cause of failure. The Univalves and smaller Crustacea disappeared first, a disagreeable smell giving intimation that decay was going on, the creatures that had perished having, many of them, died in concealment, under the stones, weeds, &c., at the bottom of the Aquarium. The first signs of unpleasant effluvia rising from the tank must, therefore, be carefully attended to; and, in such cases, the Aquarium ought to be immediately searched for the cause; which, when discovered, should be immediately removed.

Mr. Gosse having taken out the whole of the specimens, dead and alive, and carefully cleansed the tank, a much smaller number was put in, which, being well selected, and having sufficient space, throve abundantly well; and the ingenious experimentalist was at last amply rewarded for all his persevering exertions. This result benefited others as well as himself, for a general taste suddenly arose for this kind of pursuit, among all who read the various works which soon appeared on the subject; and, to gratify the new taste, a host of dealers

in Aquaria have sprung up, who are driving a brisk and profitable trade.

The first experiments of Mr. Gosse sufficiently point out the kind of cautions to be observed in the formation of a marine Aquarium. The vessel itself may be either quite plain in its frame-work, as shown in Plate XI., or made more or less ornamental, to assimilate, if necessary, with surrounding objects or furniture. The rustic style of frame, designed in Plate XII., has been found to accord well with the general character of the Aquarium itself, and it produces an agreeable contrast with the usual forms of the furniture of our ordinary sitting-rooms.

Those made by the dealers are generally formed with slate floors and backs, and zinc columns and mountings; the smallest and most simple, about fifteen inches long by ten inches broad, costing from a guinea to twenty-five shillings, and those of the proportion of two feet by one foot six costing from two pounds ten to three pounds. A small syphon will be useful, in order to remove a portion of the water, if required, without disturbance; and also a syringe, in order to aerate the water when necessary, if a second reservoir of fresh-water, in

Plate. XII.

A DESIGN FOR AN AQUARIUM MOUNTED IN HANDSOME RUSTIC-WORK.

a suitable position, should not be convenient. A miniature landing-net is also useful for the removal of decaying matter, or occasionally the living specimens when any change may be required.

A layer of sand and pebbles, about three inches deep, placed upon the slate flooring, is the first step towards arranging the interior of the tank. Upon this beginning, removing the sand and stones in places to procure a firm basis, the rock-work may be built; which should be picturesque and fanciful in character, as partially suggested in the two Plates, leaving miniature archways and caves for the shelter of such creatures as shun the light, either constantly or occasionally. Such a disposition of the rock imparts, at the same time, many pleasing effects to the pictorial composition. These matters are not, however, much attended to by dealers, whose arrangements of the Aquaria they offer for sale are generally tasteless enough. But that is perhaps all the better, as it entails upon the amateur the necessity of providing his own taste, which is at all times both a useful and pleasant effort of mind, and which, moreover, leaves, after each period of exertion, a permanent trace of an increased refinement which influences the whole character.

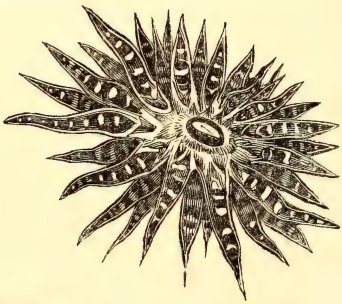
In the distribution of the rocks, I would always allow at least one point to project above the water, in order to afford the opportunity to those animals whose instincts lead them to seek occasional exposure to the air, the means of gratifying it by that contrivance. I have thought, indeed, of constructing a kind of double Aquarium, and perfecting a contrivance by means of which a large portion of water should flow gradually from one tank to the other at fixed periods, in imitation of the ebb and flow of the tide. Many interesting phenomena would be exhibited in this manner, such as the closing of the *Actiniæ* as the water receded, and their expansion as it covered them on its return. This alternation, too, might be found highly advantageous to the health and development of the animals whose natural habitat lies between high and low water-mark, and whose constitution is therefore framed to require entire or partial exposure to the air at certain intervals of time. I also prefer, as preserving a similar set of analogies, a sloping bottom, similar to that of the coast. For instance, if the slate back of the Aquarium be placed next the light, which is its proper position, as the light ought to penetrate the water entirely through its upper or horizontal surface, then I

would fill the side next the slate back nearly to the top with pieces of rock, gradually reducing their height, till, at the other side, they should hardly rise above the floor of sand and pebbles, leaving, at last, a flat portion of the pebbly or sandy bottom quite level.

When this form of rock-work is decided upon, the Aquarium should be of rather wider proportions than usual, in order to allow of the slope being pretty gradual. Supposing the tank to fill entirely the recess of a spare window, which is a position in which it looks exceedingly well, a solid slate back may be found to darken the vessel or the room too much; in such a case, a glass back must be preferred, which can be shaded from the direct influence of the light by a blue or green shade of calico neatly fitted to the frame; and it must be borne in mind, as essential, that the Aquarium must be so placed as to receive the direct rays of light during some part of the day, being screened by a white blind when the sun may be too powerful; as should the water become *tepid*, it would be fatal to many of the inhabitants of the miniature sea.

With due observance of these precautions, the amateur may hope to frame and establish an

Aquarium in a suitable form, and in a suitable position for the reception of its inmates; an account of which, and of the manner of their introduction, will form the subject of the ensuing chapters.



CHAPTER IV.

THE VEGETATION OF THE MARINE AQUARIUM.

As the forest must be planted before its denizens can luxuriate in its shades, so the submarine shrubbery of the Aquarium must be perfected before the aquatic animals can be introduced. For it has been shown, in tracing the history of the experiments which resulted in the establishment of the principles that regulate the formation of Aquaria, that it is by plants only that a supply of oxygen can be kept up, sufficient for the health and existence of all forms of animal life beneath the water.* It is necessary, also, that the rays of sunlight should fall upon the foliage directly through the surface of the water; and when an Aquarium, with its plants, is placed in a position to receive the light in this manner, their fronds may be observed giving forth the gas in small silvery bubbles and corruscations, which have a brilliant and gem-like appearance.

* Analogous principles are at work in our fields and forests, but we have now only to do with the submarine production of oxygen.

Some marine plants appear to succeed much better than others, but I believe that happens only from their treatment being imperfectly understood; and I believe, not only that all the exquisitely beautiful marine *Algæ* of our own shores may be successfully grown, but also that the more splendid varieties of the tropical seas may be made to thrive in properly-heated Aquaria, and thus form one of the most attractive features of our hot-houses—one that has not yet been dreamed of.

In ordinary Aquaria, such as I am now treating of, I shall name first those species of sea-weed recommended by Mr. Gosse and others as most easily cultivated, but I shall also point out many other species, which I feel convinced may be successfully grown under proper management; and they certainly deserve every effort that can be made to establish them in Aquaria, as they are among the most beautiful of their tribe.

If not purchased of dealers, the plants must be very carefully collected by the amateur himself, taking care to detach a portion of the substance to which they are growing, and packing them in damp refuse sea-weed, keeping them out of their native element as short a time as possible.

The plants in most flourishing condition in the

marine tanks of the Zoological Gardens, were at first those of the *Chlorospermatous* order, but others have since succeeded nearly as well. Plants of *Ulva* and *Conferva* have done very well, but the most successful growth has been that of a plant of the genus *Bryopsis*, which, entirely enveloping a large stone in its mossy and almost feather-like foliage, produces a very beautiful appearance. Those unlearned in scientific names will be glad, perhaps, to learn that these beautiful *Algæ* derive their title from two Greek words, Bryon (βρυον) a moss, and opsis (οψις), a resemblance, from their likeness to some of the most delicate and feather-like mosses of our woods. The delineation of *Bryopsis plumosa* in Plate II., on the extreme left near the lower part of the Plate, will convey some idea of these elegant sea-weeds.

Chondrus crispus is a beautiful plant, and well suited to the Aquarium. It will often be found under ledges of rock, completely concealed by a pendant veil of *Fucus*, commonly known as the olive-weed; and, on lifting the tangled mass of its rank growth, many beautiful and unexpected plants are frequently found, but none strike the explorer more than the *Chondrus*. Its nacreous tints, like those of a pearl shell, varying wonder-

fully according to situation, being very remarkable. It is the Carrageen Moss of the herb market. This plant forms the principal object in the lower part of Plate IV., to the right.

Laurencia pinnatifolia is a pretty branching plant, also varying in hue according to the aspect in which it grows. In the shade it is purple, but when receiving the full influence of the sun's rays, it assumes a light-yellow tone; just as the *Lycopodium*, known as Fortune's Moss, is purple when grown in the darkest part of a room, but becomes of an ordinary green tone when placed for some time near the light. The *Laurencia* is shown at the upper part of Plate V., coloured pale-violet.

The splendid plant *Rhodymenia palmata*, with its finely-coloured, semi-transparent fronds, is also recommended. It is the Dulse, or Dellis, eaten by the inhabitants of our northern coasts as a delicacy. Another species of *R. lacinata* is represented to the left of Plate V., the transparent light-crimson fronds of which are excessively beautiful. Mr. Gosse tells us that the *Rhodymenia palmata* is not suited to an Aquarium, because it appears to require the motion of the sea, and soon begins to decay in still water. If that be the case, let us provide a remedy, for the plant is one of the most beautiful among all its

lovely congeners. When a plant of the gigantic lily of the Amazon river was first introduced, it refused to flower in the tank provided for its northern home, at the Duke of Devonshire's residence at Chatsworth. But Sir Joseph Paxton, who then directed the floricultural operations of that magnificent abode, was not discouraged; and, seeking to impart to the still water of the tank something of the motion of a deep and majestic river, he contrived that a small but continuous stream should enter at one end of the tank, and, as it entered, turn a small paddle-wheel, the action of which imparted a gentle, undulating motion to the water of the whole tank. The device was triumphant, and the glorious *Victoria regia* formed and expanded its giant flowers in the house which its curator had constructed for it, the plan of which eventually suggested the creation of the "Crystal Palace." Let us not despair, therefore, of cultivating successfully the beautiful *Rhodymenia palmata* in our Aquaria. The construction of a suitable apparatus for imparting motion to the too still waters, will form a pleasant *passetemps* for some of our fair admirers of the pursuits of the Aquarium; and their success would be a signal triumph. But at present the beautiful red weeds, in general, are difficult of cultivation,

and when they begin to exhibit spots of orange—a vegetable plague-spot not to be mistaken—it is a symptom of decay which should at once cause their removal from the Aquarium, before their decomposition leads to further mischief.

The common Coralline, *Corallina officinalis*, of which a small spray is represented in the extreme lower part of Plate V., near the centre, is the "arboret of jointed stone" alluded to by the poet, and is well suited to Aquaria, thriving with little trouble. The smaller and slenderer kind is also suitable; but care must be taken, in collecting, not to choose the detached white fragments, which are washed up with every tide, for they are only the skeletons of the plant. It is the rosy-tinted specimens, verging to violet and purple, and still attached to pieces of rock, that are alone fit to remove to the Aquarium.

The *Cladophoræ* are also stated to be very suitable, *C. rupestris* being a very useful plant for the purpose. It is of a bluish-green, that harmonizes well with the tone of the sea-water, and fills up little chasms in the artificial rocks with very good effect, especially in contrast with the reddish-purple tufts of *Polysiphonia arceolata*, which do well in an Aquarium, and are a great aid to the foliage of the

Plate I.

1. Delesseria sanguinea. 2. Punctaria latifolia. 3. Chordaria flagelliformis.
4. Vaucheria submarina. 5. Hildenbrandtia rubra.

little marine landscape. The elegant, fan-formed, and brightly-radiated *Padina pavonia* is likewise mentioned, and should at all events be tried, as the tufts of that graceful marine plant form very singular as well as beautiful objects in the tank.*

I would also recommend the trial of all the plants delineated in the five Plates devoted to the sea-weeds in this little book.

In Plate I., the first, occupying the upper part, with leaf-like fronds of transparent crimson, is the beautiful and not uncommon sea-weed, *Delesseria sanguinea*. The delicate pale plant below, to the right, is *Punctaria latifolia*, thin as tissue-paper, and speckled over its pale-buff surface with bright but minute grains of black. To the left is a branch of *Chordaria flagelliformis*, the rich olive of which contrasts well with the red kinds of *Algæ*. In the front, growing on a detached pebble, is the Lichen-like *Hildenbrandtia rubra*, the rich carmine of which might be made to form an exquisite touch of colour, if tastefully placed in the Aquarium; and to the extreme right is a small tuft of *Vaucheria submarina*.

In Plate II., the principal object, near the top of

* A list of the plants with which Mr. Gosse furnished his first Aquarium is given in Chapter III.

the Plate, is a bush of *Callithamnion arbuscula*, which receives its name from the tree-like aspect which it assumes more distinctly than any other of the marine *Algæ*. Behind it, to the right, are the tall and graceful forms, with their crimped edges, of the slender *Laminaria phyllitis*. And below, still to the right, is a branch of *Codium tomentosum*, distinguished by its light, vivid green, and the edging of delicate ciliæ, which have the appearance of a border of paler green, to every branchlet. Still to the right, in the extreme foreground, is a broken piece of rock on which plants of the curious *Leathesia Berkleyi* have grown, like convex kernels of bronze. To the left are the red-violet tufts of the *Bangia fusco-purpurea*, and behind them, a branch of *Bryopsis plumosa*.

In Plate III. the bright-green feathery plant in the extreme background is *Ectocarpus siliculosus;* and behind it, the violet, antler-like fronds of *Nemaleon multifida*. The large, gracefully-bending frond of rich purple, with narrower and younger fronds springing from the same root, is *Porphyra vulgaris*, one of the commonest, but most splendid of our marine *Algæ*, with which, in combination with other plants of suitable contrast, the vegetation of the Aquarium may be rendered truly splendid, if

Plate II.

1. Bangia fusco-purpurea.
2. Codium tomentosum.
3. Bryopsis plumosa.
4. Callithamnion arbuscula.
5. Leathesia Berkleyi.
6. Laminaria phyllitis.

it once be successfully cultivated; of which I have no doubt, when its natural wants are sufficiently studied and ingeniously supplied. The splendidly-marked plant to the right, with its black maculations and richly-frilled edge, is *Nitophyllum punctatum*, one of our most splendid species; and the curious pale-buff, tubular plant in front of it, is *Asperococcus Turneri*. Near the foot of the *Nitophyllum* is a little tuft of the delicate *Dumontia filiformis;* and, to the extreme left, a branch of the brown-fronded *Rytiphæa pinastris*, which receives its specific name from the somewhat Pine-like growth it frequently assumes. Immediately beneath it, on the extreme right, is a little cluster of *Chordaria divaricata;* and below, in the left foreground, are a few pink fronds of the curious Alga, *Chrysemenia rosea;* while, in the foreground, to the right, on a detached pebble, is a small mass of the pale-crimson *Peyssonetia Dubyi.*

In Plate IV. the principal object is a fasciculus of *Taonia atomaria*, rising behind the point of rock at the top of the Plate, behind which are two long fronds of the spotted *Asperococcus;* to the left is the horn-like *Gigartina acicularis;* and in the front, to the left, the crimson tufts of a pretty weed

(*Ceramium strictum*), which our artist has made too like the *Bangia fusco-purpurea.*

In Plate V. the violet-toned *Laurencia pinnatifolia* is grouped behind the solid, deep-crimson fronds of *Iridæa edulis*, which are often perfectly Pear-shaped, like pieces of crimson leather neatly cut in that form; but the action of tides in rough weather often tears the edges, and wears holes through the texture of the plant, as shown in the principal frond. To the left is the bright-crimson *Rhodymenia lacinata*—one of our most exquisitely beautiful marine *Algæ*. The fronds are as thin as the finest conceivable tissue, and beautifully transparent, which is shown wherever the lacinations of the edge overlap each other, in which places the double thickness of the texture doubles, at the same time, the intensity of the colour, as indicated in the representation. On the same level, to the right, is a small group of the delicate green *Ulva latissima*—a plant which has proved useful beyond all others in Aquaria, as throwing off, under the action of the light, a much greater profusion of silvery globules of oxygen than any other species yet known. At the same level still, on the extreme right, is a sprig of the delicately-branched parasite, *Polysphonia*

Plate III.

1. Porphyra vulgaris.
2. Dumontia filiformis.
3. Asperococcus Turneri.
4. Rytiphlæa pinastris.
5. Chrysymenia rosea.
6. Peyssonetia Dubyi.
7. Chordaria divaricata.
8. Ectocarpus siliculosus.
9. Nemaleon multifida
10. Nitophyllum punctatum.

parasitica, growing on a small mass of pale sulphur-coloured *Melobesia lichenoides*, the Lichen-like Melobesia. To the extreme left, under the beautiful *Rhodymenia*, is a small branch of the bright, olive-tinted *Ectocarpus tomentosus*, looking much like a spray of wild Broom, and immediately below it, a few purple branchlets of *Gracilaria confervoides;* while in the left foreground lies a pebble, partly covered by a small plant of *Zonaria parvula*, from beneath which straggles a little branch of the common but pretty Coralline, the *Corallina officinalis;* and, to the right, a globe of the curious *Codium bursa*, of the French coast, which might easily be added to our native species in the Aquarium.

Such are a few of our beautiful coast *Algæ*, all of which I would advise the admirers of the beauties of the marine Aquarium to try; and if some refuse, in the present state of our knowledge of their habits and requirements, to make themselves happy in their pretty "crystal palace," choosing rather to consider it a "prison of glass," still a good number of them, I am persuaded, may be coaxed into displaying their beauties very genially within its transparent walls, which admit the bright sun rays as freely as the pale-green liquid glass which forms their native element.

The best time for making collections at the seaside is a day or two after the full moon, when the tide recedes to its greatest extent, and parts of the shore become exposed, where some of the finest species grow, which cannot be conveniently approached at any other time. It must be borne in mind, also, that few of the floating pieces will grow, however fresh and seemingly washed off with their root. Certain success is only to be secured by chiselling off a portion of the substance on which the weed is growing—thus transplanting it with its own soil, as it were, about its roots, into the ocean garden of the Aquarium.

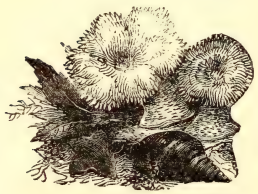


Plate IV.

1. Chondrus crispus. 2. Gigartina acicularis. 3. Ceramium strictum.
4. Taonia atomaria. 5. Plocamium coccineum.

CHAPTER V.

THE ZOÖPHYTES.

THE Aquarium having been furnished with its vegetation, and rendered as picturesque as possible by the well-arranged juxtaposition of felicitously-contrasting forms and colours, the water must be allowed to settle for some days, until it is as clear as pale-green crystal, before the animals are introduced to their new home. When the Alpine scenery of the submarine landscape appears perfectly settled, and all its colours and forms are seen with beautiful distinctness through the clarified waters, then the still life is ready to be associated with the more active organizations of animated creatures. Before speaking of Molluscs, or Crustacea, or of Fish, suitable to the Aquarium, let us first devote all our attention to our *Zoöphytes*, those singular creatures whose strange instincts and anomalous forms have been mainly instrumental in attracting the attention of many classes of the public to that curious interest in Aquaria, which is fast spreading into a mania, threatening to absorb all others in its

vortex, like *Infusoriæ* drawn within the fatal tentacles of the *Actinia*.

First, of the *Actiniæ*, or Sea-Anemonies. These flower-formed animals were once thought to form a curious and astonishing link between the animal and vegetable world; and many curious speculations, based upon that idea, were put forth, among which the links between man and the inferior animals, and between quadrupeds and fishes, were asserted in further illustration of the theory. But the deceptiveness of superficial knowledge, based upon imperfect observations, was never more strikingly exemplified than in the present instance. It was thought that, because these creatures were found attached to rocks, they necessarily drew their nourishment principally through the medium of roots, as all true plants do; more accurate observation, however, has shown that they are not *permanently* fixed to the rocks, and that they have the power of moving from one place to another, and attaching themselves anew, whenever a sufficiently disturbing cause renders such removal desirable. Again, oysters and mussels remain fixed to rocks without being considered allied to plants on that account; and even some fish have the power of attaching themselves to such and other substances by means of curiously-formed

ventral fins, peculiarly fitted for the purpose. The pretty little two-spotted sucker, *Lepidogaster bimaculatus*, possesses this faculty.

But the flower-like form into which the arms, or food-seizers, of the *Actiniæ* are spread, radiating from a centre like the petals of a flower, was the main reason for supposing a close analogy between these strange creatures and plants—a fancy now utterly abandoned, as it is quite evident that they are furnished with a mouth and stomach, like all true animals, and with a set of arms called tentacles for seizing their prey; and, perhaps, at the same time, through the medium of delicate ciliæ with which the tentacles are connected, with a breathing apparatus, through which a current of water is taken in, and discharged after its oxygen has been abstracted.

The discovery of the true nature of these singular creatures has not, however, changed their flower-like appearance, which to a superficial observer is as deceptive as ever; and few (not professed naturalists), observing these singular *Zoöphytes* for the first time, would hesitate to pronounce them a kind of sea-plant.

Let us turn, for example, to Plate VIII., and note the appearance of the two varieties of *Actinia*

dianthus—the carnation-like *Actinia*, as its name imports—and we shall easily excuse our early naturalists their pretty but erroneous fancies concerning them. This species is more subject than many others to vary in colour, even like the flower after which it is named, being found of every tone between snow-white, orange, pale scarlet, and blood red—while some specimens take duskier tints, from a dull brown to a kind of orange green. But we will describe our illustrations of this genus in regular succession, noting what is most peculiar in the subjects of each Plate.

Plate VI. contains a representation of one of the last-discovered species of *Actiniæ*—one which displays a habit that distinguishes it from all its congeners hitherto described by naturalists, and which has entitled it to be classed as a separate genus, and named *Edwardsia vestita*. The generic name is from that of a well-known naturalist, and the specific name, *vestita*, from its habit of forming for itself a shell, or clothing, into which it has the faculty of retiring at pleasure; or, if an inhabitant of the shallow water, when the tide recedes, and leaves it inconveniently exposed to the air. This species, unless it have the power of quitting its shell, like some Molluscs, is of necessity permanently fixed and

Plate VII.

1. Actinia clavata. 3. Pennatula phosphorea. 5. A group of Ascidians.
4. A Shell of the Common Whelk, on which are two specimens of Balanus.

confined to the position in which the egg from which it was hatched was placed by the instinct of the parent, or the caprice of the waves. The other objects in Plate VI. will be described in another place.

In Plate VII. we have two remarkable species; the one with drooping tentacles of dull brick-red, being a very curious variety. The species below is *Actinia clavata*, one of the most delicately-beautiful species, which, from its brilliant whiteness, at once attracts the attention.

In Plate VIII. are two varieties, previously described, of *Actinia dianthus*, the plumose or feather-like Anemone. In front, below them, is the representation of one of the most splendid of all the species, having received the specific name *Gemmacea*, from the gem-like appearance produced by the touches of colour—blue, buff, and brown—about the orifice of the mouth or stomach, and about its sharply-pointed tentacles. The stem or body is also variegated with rows of brightly tinted tubercles, and its whole surface is clouded with pale iridescent, or rather nacreous, tones of pink and azure, varied with occasional flashes of orange. All the species are furnished with tubercles of a similar description about the stem or body, but in many they are not so conspicuous, and in others almost imperceptible;

yet they no doubt exist in all, as they are not merely ornamental, but essential organs, peculiar to this class of creatures; being reservoirs from which they can shoot forth a thread, furnished with a barbed and poisoned dart, by means of which they are able to attain an enemy, or victim, far beyond the reach of their tentacles. Mr. Gosse very graphically describes the death of a small fish struck by one of these thread-borne poisoned arrows, at some distance from the offended *Actinia*, who launched his dart, as it seemed, for no greater provocation than a slight disturbance of the water rather nearer to his retreat than was agreeable.

The *Actinia gemmacea*, it would appear, is a more voracious creature than most of his congeners, for Dr. Johnston, in his splendid work on the British Zoöphytes, describes one of this species that had managed to swallow a shell of *Pecten maximus* as large as a common saucer, its own natural diameter not exceeding two inches. It managed, however, to distend its elastic form sufficiently to receive the enormous prey; but the shell divided the stomach into two completely separate departments, the lower one being thus perfectly shut off from its usual supplies. To meet this difficulty, the organic economy of the creature adapted itself

Plate VIII.

1. Actinia gemmacea. 3 & 4. Actinia mesembrianthemum. 5. Lucernaria auricula. 6. Virgularia mirabilis.

in a most extraordinary manner; a new mouth was opened below the division, furnished with two rows of new tentacles, and thus the lower portion regained a means of taking in nourishment, the whole creature forming a singular double monster, that, not contented with its one giant mouth, surrounded with its hundred arms to supply its voracious appetite, had actually succeeded in supplying itself with a second, equally furnished with its formidable feeding apparatus.

In Plate IX. a very beautifully distinct form of this singular race of animals is very carefully delineated—*Actinia anguicoma*—which seems to be shaking loose a mass of serpent-like hair, like another Medusa; from which appearance, its specific name *anguicoma*, signifying snake-haired, has doubtless been given.

The tentacles of the *Actinia mesembrianthemum* are generally of a beautiful rosy-pink, and the body of a rich warm brown. But of all the species, *A. crassicornis*—represented in the lower part of Plate X.—is perhaps the handsomest, the orifice or mouth being of a delicate straw tone, the tentacles white, variegated with bands of delicate pink, and the body, or stem, a rich orange-brown, thickly sprinkled with tubercles of bright yellow. This fine

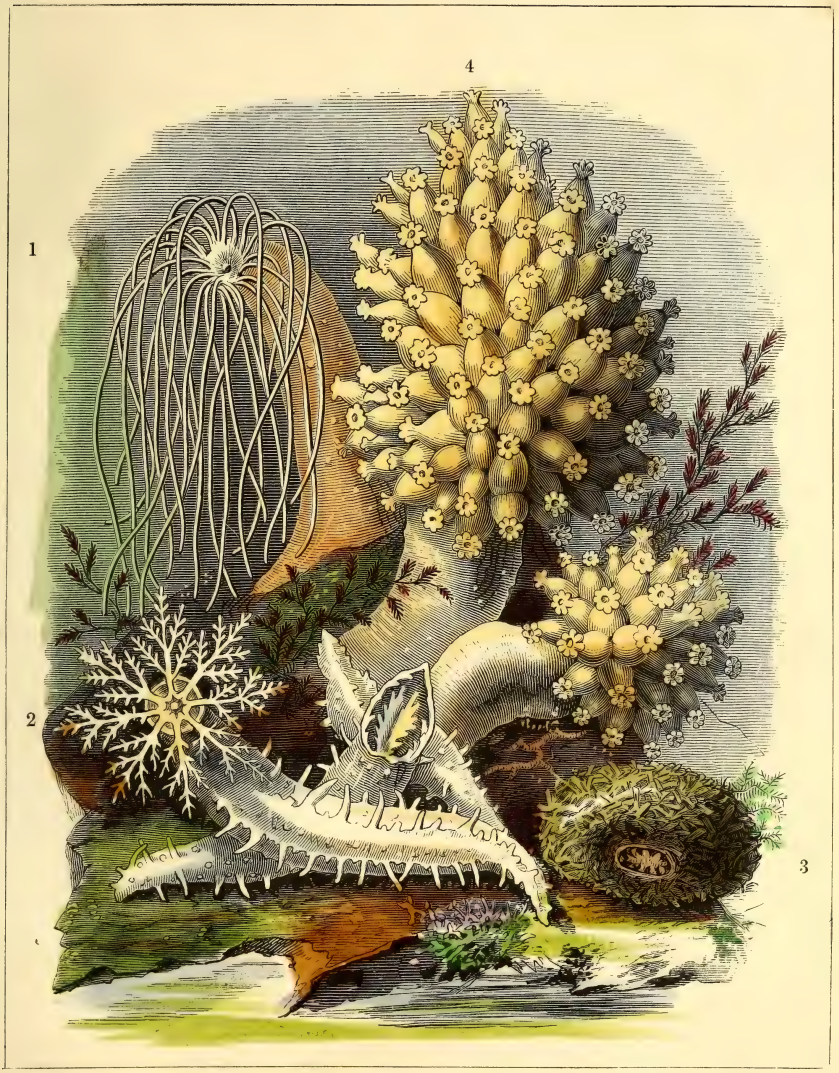
species sometimes measures five inches across, when the tentacles are fully expanded.

When the *Actiniæ* are in a state of repose or sleep, the tentacles are entirely drawn in, and the stem or body closes over the orifice, leaving only a slight indent to mark its existence. In this state they might be mistaken for short-stemmed fungi, the pale-bodied species being very much like a half-grown mushroom, if one can imagine it placed close to the ground, without any visible stem.

Most of the species can be easily detached from the rocks to which they are found adhering, but in some cases it is found necessary to cut out the portion to which they cling, by means of a hammer and chisel. But when this is done, and they are placed in the Aquarium, they often willingly leave the stone to which they are attached, which they would not do by gentle persuasion, or any moderate amount of force; and they then take up their station on some suitable portion of the artificial rock-work, just as those do that have been originally detached from their native rocks. Above twenty species of *Actiniæ* are known to British naturalists.

The *Lucernariæ* are another class of Zoöphytes, or plant-like creatures, as the term *Zoöphyte* implies,

Plate IX.



1. Actinia anguicoma. 2. Cucumis hyalinus. 3. Echinus sphæra. 4. Alyconium digitatum.

being formed of the Greek word, *Zoön* (ξωον), signifying a thing possessed of animal life, and *phyton* (φυτον), a plant. This general term is applied to all the creatures—some of very distinct character—that belong to this class, which forms a separate division of natural science, known as Zpoöhytology.

The species of *Lucernaria*, which has received the specific denomination of *auricula*, from its slight resemblance in form to the flower of that name, is delineated in Plate VIII., attached to a slender branch of sea-weed, just above the two large Sea-Anemonies. This species of *Lucernaria* is generally of a light pinkish colour, and is, in general form, perhaps more like a Convolvulus than an Auricula. Two species have been most beautifully delineated in all their details by Mrs. Johnston, in her husband's magnificent work on British Zoöphytes. These drawings are, in fact, so charmingly and, at the same time, accurately executed, that it would seem that the pencil ought to be guided by delicate female fingers when portraying these minutely-intricate and unusual forms of animal life. The exquisite drawings by Mrs. J. E. Gray, in her work on the curious molluscous animals, whose habitations alone, the beautiful sea-shells of our cabinets, were, till recently, all that was known of them, afford further

evidence, if it were needed, of the aptitude of the more finely-strung female capacity for this department of scientific portraiture. The name of Mrs. Griffiths is also honourably associated with the study of natural science, especially that connected with our marine *Algæ*—a beautiful division of sea-weeds—having received its name Griffithsia, in honour of the esteemed services of that accomplished lady.

The *Lucernaria campanulata*, which is of a somewhat more bell-shaped form than the preceding, is of an uniform liver colour; and in the hollow of the flower-like cup the "mouth" projects, in a square form in the centre. There are three known species of British *Lucernariæ*, which would all form highly curious objects in the Aquarium; but they are excessively delicate and fragile creatures, hanging suspended from the object to which they are attached, when taken out of the water, like a mere lump of jelly, and would doubtless be very difficult of transport, and probably not capable of retaining life in a state of confinement, except for a short time.

The "compound Zoöphytes," or, more properly, *Polyps*, as being, as it were, many creatures in one, are still more curious than the two classes just

described. A common example of this class is the *Alyconium digitatum*, looking like a mass of short fingers, when the final florets are closed, as its specific name imports, being sometimes called, by the fishermen of our northern coasts, Dead-men's-toes. Each finger-like cell contains a separate creature, whose tentacles, when expanded, form the floret, after the manner of those of the Sea-Anemonies, but yet each separate creature is vitally attached to a central polypidom, or spine, which binds the whole group into one existence.

Of this class are the curious *Pennatulidæ*, one of which is commonly known as the Sea-Pen. The three species of this class of *Polyps* known to inhabit the British seas, are so distinct from each other that they form at the same time three distinct genera. The most beautiful of the three is the *Pennatula phosphorea*, the Sea-Pen, which is not uncommon on some parts of our northern coasts. It is represented in Plate VII. The purple branches, or pinnæ, of the upper portion, form the feathered part of the quill pen to which it is likened; the bare portion of the polypidom below having certainly some resemblance to the quill. This curious zoöphytic form is often seen in an erect position, planted, as it were, in the mud like

a miniature purple Pine, though it is capable of motion through the water from place to place, by some action of its organs which has not been accurately detected. It is one of the handsomest of our British Zoöphytes. The polypidom, or trunk, is three or four inches long, fleshy, and of a purplish red. It is naked at the lower end, and feathered above with long, closely-set pinnæ, along the margins of which the polyp-cells are placed. The pinnæ are curved backward, and capable of either separate or united motion. They are supposed by some to be capable of the action of regular oars; but this is very doubtful, though their bearing on the polypidom, which is strengthened by an internal column of calcareous or bony matter, would give them considerable power for that purpose. The creature's specific name, *phosphorea*, must not lead to the supposition that it always emits a phosphorescent light, for it is only when irritated that this is produced. If plunged into fresh-water, it scatters a shower of phosphoric sparks in all directions, which forms a magnificent and curious spectacle, far more brilliant, no doubt, than the fabled hues of the dying dolphin.

The *Virgularia mirabilis* is another of this class of creatures, almost as elegant as the Sea-Pen, but

more slender, and in the form of a branching rod, as its name imports. (See Plate VIII.)

The Sponges form a curious class of Zoöphytes, which have perhaps a much closer affinity to plants than any other. They are occasionally very sportive, and curious in their forms; and Dr. Johnston enumerates fifty-six species belonging to our coasts; they are, however, unsuited to the Aquarium in the present state of our knowledge; and when portions of rock are collected on the shore, for the tank, care should be taken to clear off any Sponge formations that are perceived, as their certain and rapid decay would be liable to injure the condition of the whole colony of the Aquarium.

CHAPTER VI.

THE MOLLUSCS, ETC.

THE curious floral forms of the Zoöphytes have, as yet, attracted the greatest degree of attention among the constructors of marine Aquaria; yet other forms of ocean life offer equal, if not superior, opportunities for curious observation, and are equally well calculated to bear the confinement of the tank. Among them all, none more than the Molluscs, especially the shell-bearing division, which merits the careful attention of the student of Nature, as forming some of her most singular manifestations.

The knowledge of the nature and structure of many of the most curious shell-bearing Molluscs is of very recent date, with the exception of those which possess obvious qualities which have fitted them for articles of diet or commerce; such as the Oyster, Mussel, Cockle, &c., as eatable species—and the Purples, Sepias, and Cuttle-fish, as containing valuable dyes. With the exception of such as these, the pearl-yielding Bivalves, and a few others, nothing was known, with a few remarkable exceptions, of

the animals that create and inhabit the beautiful shells that have so long been ranked among the most elegant objects of the cabinets of the curious. Many of these were, in fact, scientifically classified by learned naturalists before the nature of the animal, of which they formed the mere senseless husk, was even guessed at. The ordinary collector did not even desire to know anything of the creature which produced the shell he most prized; it was sufficient for him that it was estimated as "rare" by his brother collectors—rarity being a quality more highly prized than even beauty. With this feeling, prices as great were given for single shells as ever enthusiastic Hollander paid for a coveted bulb during the height of the Tulipomania. No amount of guineas was too much, at a sale of shells, for such a contested prize as a *Many-ribbed harp*, a *Gloria maris*, a *Cedo nulli*, or a *Voluta Junonia*. But that race of idle shell-fanciers has given place to a race of true conchologists, who are investigators as well as collectors, and whose labours are daily developing unexpected and valuable knowledge from those long obscure pages of the great book of Nature.

The marine Aquarium may be made the means of many curious discoveries regarding the habits

and organization of the shell-bearing Molluscs; and, with this feeling, I may direct the attention to several of their singular characteristics, in order that they may serve as clues to the detection of others.

The term Mollusc, from *mollis*, soft, is intended to express that the whole class are invertebrate; that is, entirely without spine, or any bony support to their curious fleshy forms. The term was invented by the illustrious Cuvier, but is objectionable as a distinctive one, the characteristic on which it is founded being shared by other distinct classes of animals. When, however, the application of a term is well understood, its inner signification becomes unimportant; it is, therefore, now too late to criticise the one invented and applied by the prince of modern naturalists.

Among the interesting facts detected by recent science, it has been shown that many of the seemingly shapeless masses of soft substance, scarcely to be termed flesh, possess all the senses of the higher animals. In the *Cephalopoda*, the organs of sight and hearing are both well developed; and Professor Owen considers that the Nautilus possesses even an organ of passive smell. The *Gasteropoda* too, are, according to Siebold, nearly all furnished with ears and eyes, the former organs being described

as forming round capsules, conspicuously visible near the roots of the tentacles.

Some of the *Conchifera*, also, are furnished with numerous eyes, which, like those of the Scallops and Clams of our own shores, are also placed among their tentacula.

It appears probable, says Dr. Johnston, that many have also the sense of taste, as they are observed to select particular articles of food in preference to others, and there is no other sense that appears fitted to regulate the choice. The mouth, as it is termed, of many of the molluscous tribe is furnished, as among the *Gasteropoda*, with a fringe formed of filaments, which may be organs of touch, and they have also a complicated breathing apparatus.

The strength of these boneless creatures is something very extraordinary, and almost incomprehensible. The *Strombus gigas*, a soft, snail-like creature, carries a shell which often weighs more than five pounds; the *Cassis tuberosa* supports one nearly as heavy, and the naked Molluscs, that have no shell to carry, have other modes of exhibiting strength of a very extraordinary character.

The shells of the clothed Molluscs are senseless, being permeated by no vessels, and are formed by

the animal itself from a secretion with which its outer integuments are invested, and which may be described as lime in a state of solution. The thickened edge of the mantle, by means of which the form is given to the shell, and the general manipulation effected, is furnished, as may be seen with the aid of a moderate lens, with a minute and highly sensitive fringe, the cilia of which are of various colours, corresponding in tone and position to the tints which decorate the exterior of the shell. The coloured cilia or fringes have doubtless a dyeing power, which colours the calcareous solution at the time it is added to the shell by their plastic instinct. The solution becomes a hard testaceous substance so soon as it leaves the body of the animal, and is deposited in architectural layers upon the beautiful structure of the shell, by the "trowel" and "brushes" of the edge of the mantle.

This process is beautifully described in Jones's "Animal Kingdom," with all the details relating to the successive ridges on the shell, which mark the age of the animal; it having been ascertained what time is required for the completion of each story of the edifice.

The power of locomotion is one of the most curious subjects for observation in the structure of

shell-coated Molluscs, and for this purpose the marine Aquarium offers many advantages. Other classes of animals have been distinguished by the number of their feet; we have, for instance, a tribe of worms termed centipedes, or hundred-footed creatures; and, to pass over many gradations, to the superior grass-feeding and carnivorous animals, we find them termed quadrupeds, or four-footed creatures; while the human race, along with birds, has been termed biped. Why, therefore, may we not coin a word for our present purpose, and call these curious Molluscs monopeds, or single-footed creatures?—for they walk with a single foot, being compelled to do so by the very simple fact that they have no other. This limb, or foot, being gradually protruded, its bearing against some substance forces them forward, and when the foot has attained its full distension it is drawn in, and a new bearing obtained, and by the repetition of this process, a certain amount of locomotion is effected. Some species float on the surface by means of this foot. Having crawled up a rock to the height of the surface of the water, the foot is protruded and exposed to the air, when it becomes suddenly dried, and in that state serves as a cork, which enables the animal to float away close under the surface of

the water. But if any agitation of the water wet this floating apparatus, or the animal withdraw it voluntarily beneath the water for that purpose, the creature immediately sinks to the bottom.

The swimming power of this race of creatures is equally curious. The *Cephalopoda*, by the ejection of a jet of water, propel themselves rapidly in the opposite direction, and by the repetition of the jet at regular intervals, a beautiful power of motion is obtained, as regular, and with less labour than that of ordinary swimming by means of the action of fins or other oar-like limbs adapted to the purpose.* The *Pteropoda*, however, in their little shells, translucent as glass, swim by the action of small fin-like paddles placed near the head.

The *Bivalves* do not make so clever a use of their single foot as the *Univalves*. The foot in this tribe appears to be furnished with a terminal hook, which, when the foot is protruded, clings to some substance, and the animal is drawn up to that point, when the operation has to be repeated; this

* Some species effect leaps by an analogous contrivance—collecting water within the closed mouth, and then emitting it at a gush from a small portion of the aperture, suddenly opened, which propels the creature to a considerable distance, as it were, at a single bound.

appears likely to produce but a slow rate of progress, yet some of the sand-boring *Bivalves* manage, when alarmed, to conceal themselves with great rapidity by that means.

The *Mollusca*, as feeders, are divided into three classes—those which take only liquid food, the vegetable feeders, and the carnivorous species.

Those which are only able to take food in a liquid form, are such as have no means of seizing prey, their food consisting of the countless myriads of infusorial animalcules which float in the sea-water, and which are carried into the orifice of the stomach or mouth by the current. Of these, the *Dunicata*, *Brachiopoda*, and *Conchifera*, are examples.

The liquid feeders exhibit a very low form of molluscous life, but other classes are furnished with means of defence and aggression, equal to those of terrestrial quadrupeds, and much more extraordinary in their form. Some of the carnivorous *Univalves*, for instance, feed upon the *Bivalves* by drilling a hole through the solid shell, and withdrawing the animal piecemeal, as required.

The *Eolis papillosa* has been observed tearing away the tentacles of different species of Sea-Anemone with extraordinary voracity, and the tribe must therefore very evidently be excluded

from the Aquarium. The Cuttles, also, are to be avoided from the same cause; they are fierce tyrants of the deep, that would make sad havoc among the delicate creatures with which we delight to furnish our tanks of glass. The curious substance termed Sea-Grapes, which are the eggs of this creature, might, however, be placed in the tank, and the progress of development watched, without fear of injury to the other inmates.

The full-grown Cuttle is, nevertheless, so curious a creature that, in a tank prepared with that special view, his habits might furnish food for much curious observation—indeed, carefully fed up, he might form very excellent food himself; his German name, *Kuttel*, signifying tripe, the flavour of which his flesh is said to resemble. The common Squid, which is eaten by the poor of our coasts, is a kindred species, and is also said to have a similar flavour. Molluscs of this class, as well as the disgusting-looking Poulp, or many-feet, are seen in profusion in the markets of the south of Europe, and are as highly prized as the Oyster with us. The ancients carried their taste for them so far as to feed them up artificially; and at the nuptial feast of Iphicrates, one hundred *Polypi* and *Sepiæ*, as we are informed, were disguised with different sauces,

each imparting a different flavour. The land Molluscs were also much sought as a table delicacy, a species of the large Garden-Snail being bred for that purpose, and fed upon a prepared paste, which so accelerated their growth that we learn, from the industrious Pliny, of their attaining to enormous dimensions; the shells of some of the finest being capable of holding eighty measures of water, called quadrants. But in speaking of Molluscs, I must principally confine myself to such as are suitable for an Aquarium.

Among the Sea-Snails of our own coast, which are still eaten by the lower orders, is the Periwinkle, considered by some superior in flavour to the Oyster or Shrimp. This creature, the *Littorina littorea*, is one of the most useful creatures in an Aquarium, cleansing it from all decaying vegetation, which is its natural food. The Periwinkle varies much both in size and colour, the ground tone of the shell being sometimes red, orange, or even scarlet, sometimes with and sometimes without handsome black bands. Such as are coloured in this attractive manner should obviously be selected as inmates of the Aquarium, in preference to the dull-coloured varieties; and a few of the small yellow kind, *Littorina littoralis*, may be added by way of

variety, though they do not succeed so well in confinement as the other species.

The Whelk, *Buccinum undatum*, another of the snail-like Molluscs of our coasts, which is considered good eating by the lower orders, and often seen on fish-stalls at particular seasons, is well worthy a place in our miniature sea; especially under certain circumstances, when the shell of this creature assumes a most singular aspect, well calculated to excite the wonder of the young naturalist. It is sometimes found surmounted by a mass of living substance, which might be taken for the body of the creature, residing in preference on the roof of its dwelling during the summer months, as it may be observed spreading a set of tentacles, from a mouth-like orifice, for the collection of food. Within, however, a pair of protruding eyes are seen glaringly on the watch for prey, and another set of food-clutching machines may be noticed beneath them, ready for their work, and only awaiting the opportunity. They look much like the claws of a lobster, and if any suitable object comes within their reach, it is seized by one or both of these two-fingered hands, and carried to the yawning mouth beneath; but before it reaches that evidently impatient receptacle, a brightly-shining crimson finger, orna-

mented with two white stripes, darts from beneath those claws and mouth, and, snatching away the rich morsel, disappears as suddenly as it came, leaving the expectant mouth and astonished claws both empty. The mystery of this seemingly compound creature having, as it were, a first-self living outside the house and getting a separate living, a second-self located in the front parlour, and prevented from eating its own dinner by a third-self residing in the back parlour, may be easily explained, now that the persevering observations of our naturalists have solved it. It is as follows:—

The internal dweller in the front parlour is the Hermit Crab (*Paguras Prideauxii*), a creature seldom contented with its own pretty solid habitation, but ever seeking some further protection, which it generally finds in an empty Whelk-shell. It is, moreover, very particular as to *fit*, and other details; for it has been observed, when looking out for a house, to try and reject many before finally adopting an abode. The inhabitant of the back parlour is the Sea-Worm, *Nereis bilineata*, a creature which, instinctively knowing the voracious propensities of the Crab, and determining to share his abundant feasts, seizes his opportunity, when mine host of the Whelk-shell is pretty well surfeited and in a semi-dormant state,

to sneak past the dangerous claws into the "back parlour," which is the interior of the narrow spiral of the shell—a form of apartment which affords him a most comfortable and convenient home, in which, by the superfluous voracity of the Crab, he is furnished with board as well as lodging. The external tenant of the Whelk-shell is a parasitic Sea-Anemone, known as the Cloak-Anemone, from its power of nearly enveloping the object to which it attaches itself, by means of the extension of its stem or body. It is known in scientific classification as *Adamsia palliata*, having been made a separate genus, and its specific name ingeniously taken from that of the Roman cloak, the well-known pallium of the classical writers.

Almost invariably, when the Hermit Crab is discovered inside the Whelk-shell, the *Adamsia* is found outside; and the Hermit is seldom without his dinner assistant, the prettily-striped *Nereis*. This fact is so well known to fishermen, that when in search of this worm, which is an excellent bait, they never fail to break the shells tenanted by the Hermit Crab, and are seldom disappointed in finding the object of their search in his company.

Another parasitic Anemone, still more fond of travelling, the *Actinia parasitica*, often selects the back of

the Crab himself (generally *Paguras Bernhardus*), and in that position is hurried along, in the sidling gallop of his steed, in a way that must often prove inconvenient; for in passing under ledges of rock, the Crab, doubtless, only takes his own measure. Yet, in such cases, the Anemone probably knows how to take care of himself; and when *Bernhardus* becomes skittish and adventurous, "draws in his horns," as many other bold spirits are obliged to do at certain crises of their career; and in this state, presenting only a semi-spherical mass of tough leathery substance, he can fearlessly allow himself to be driven beneath stony archways, or under impending branches of the marine forests, by his ferocious Jehu, with less chance of injury than the outside passenger of a terrestrial stage-coach passing beneath the low gateway of some inn-yard.

Our largest native shell of the Whelk tribe is the *Fusus antiquus*, often used by the Shetland islanders as a lamp; for which purpose it is suspended horizontally, the cavity holding the oil, and the wick projecting from the canal.

The Whelks belong to the interesting family *Muricidæ*, some of which, natives of our own coasts, are very pretty objects for the Aquarium. It was the *Murex trunculus* which yielded the Tyrian

purple, different species affording distinct tones of colour. In form, these shells are somewhat like our common Whelk, but finely marked with broad, dark, spiral stripes. The ancient mode of extracting the dye, as described by Pliny, was verified by Mr. Wild, in 1838, in a very interesting manner. In the neighbourhood of the site of the ancient Tyre, he found, in the rocks on the sea-shore, a vast number of round cavities, evidently the work of the hammers and chisels of long ages past. These cavities varied in size, from that of a small flower-pot to that of a cauldron, and round about them still lay scattered immense masses of the remains of the shells and bodies of the *Murex*, in many instances aggluminated together. They had evidently been pounded in those cavities, exactly as described by Pliny, and the dye extracted according to the formulæ so graphically detailed by the ancient naturalist.

The *Purpura lapillus* of our own shores yields a similar dye, and may be kept in our Aquaria as a reserve bottle of "marking-ink;" for the ingenious Mr. Gosse has shown how its dye may be thus used for household purposes. The shell is a small white univalve, with one or more bands of pale brown. It perishes on being immersed in fresh-water; and a thick vein of yellowish white, near the head, contains

the dye, which is a liquid of a creamy thickness and of pale, indistinct colour. But if it be painted in the forms required, as a cipher, or any other ornament, on linen, or any other textile fabric, with a camel's-hair pencil, and exposed to the air, it rapidly assumes a yellow tone; which first changes to green, then blue, till at last it becomes a full strong indigo, exhibiting plainly all the forms that have been traced. A crimson-red change next ensues, and the final colour, which is indelibly permanent, is a reddish purple.

There is also a large naked Mollusc, one of the *Aplysia*, that pours forth, under excitement, a secretion of rich purple hue; but the colour is considered valueless as a dye, from its extreme volatility, though it is stated that it may be rendered permanent by means of nitric acid.

The common *Planorbis corneus*, a shell coiled in the form of a ram's horn, has a similar property; but the colour of the fluid is still more volatile. The purple liquid, however, contained in another of our native shells (*Scalaria*) is very permanent.

It is well known that the ink of the Chinese, which we term Indian ink, is prepared from the Cuttle, and the Cuttles of the Mediterranean Sea furnished the principal black inks and dyes of the

Greeks and Romans. It is a kind of *Sepia*, in fact, that still furnishes the rich brown colour which bears the name of the animal from which it is derived.

The common *Sepia vulgaris* might form an appropriate specimen for a marine Aquarium, many of its habits being singular; and its power of enveloping itself in a cloud of its own rich dye may often be observed when it is irritated by the presence of a real or fancied danger. It has the faculty of propelling itself hither or thither by the emission of a jet of water, as described in speaking of the locomotive power of other Molluscs, with the additional faculty of guiding its motions by the rapid movement of two fin-like paddles, which, when in agitation, produce an effect not unlike the fluttering action of the wings of a moth. This little *Cephalopod* has large projecting eyes, and a group of arms that hang listlessly down when the fins are in motion. It changes colour fitfully and beautifully, exhibiting in the course of such changes pretty metallic spots and rings, which appear and disappear, now like gold, now like silver, as seen through a semi-opaque substance. The whole creature is at one moment of a dusky gray tone, but fitfully changes to white or deep brown when

alarmed. These little creatures are exceedingly voracious, and when one was observed by Mr. Gosse to seize another of its own species, the victim shot out its defence of dark black fluid.

Some of the *Trochus* tribe of shells look pretty in an Aquarium, but at present their treatment is so imperfectly understood, that they do not seem to do well. The specimens can, however, be renewed as required.

Trochus ziziphinus, the pearly *Trochus*, the animal of which is of a rich orange colour striped with black, moves freely about, and forms a very attractive object. The animal of *T. granulatus* is larger and handsomer, but shy, and displays little activity in confinement. The small *Trochus*, *T. cinerarius*, if placed in an Aquarium, may be observed rasping down the minute Confervæ that grow on the inside of the glass; and the curious method of the operation, and the singular instruments with which it is performed, may be observed by the aid of a small pocket lens.

Limpets—those curious bonnet-shells, as they are termed in some places, which are found in the form of a flattened and inverted funnel, adhering closely to the flat rocks of the sea-shore in all the European seas—are more curious than they appear

at a first glance, and have characteristics that well repay the labour of persevering observation. I should always place a few in an Aquarium.

The common Limpet (*Patella vulgata*) has a power, which appears extraordinary when the soft substance of its body is considered, of excavating, more or less deeply, a portion of the rock which it makes its home. It is supposed to leave its hollow in the night, returning infallibly to its home in the morning. This habit might be watched in an Aquarium, and, if verified, a very interesting fact would be established, which at present remains somewhat doubtful, although Mr. Lukis, of Guernsey, marked a Limpet, and found it return to its haunt. These creatures belong to the order named *Cyclobranchiata*, from the breathing apparatus being arranged in a circle round the body. The pretty British shell, vulgarly called the Ark of Noah, but which is the *Arca tetagrona*, should be tried in Aquaria, as well as the elegant Heart-shell of the beautiful genus *Isocardia;* the movements and habits of the latter, as described by the Rev. J. Bulwer, being very curious and interesting.

The pretty little Cowry is an object that must not be passed over in silence, when treating of objects fitted for the marine Aquarium, although,

in a little book of this extent, many others must of necessity be omitted. This beautiful little creature, *Cypræa Europæa*, carrying its porcelain-like dwelling on its back, is enabled to move steadily along by the action of its single foot. When in action, the mantle, as it is termed, which is the general covering of the body, is greatly distended, and protrudes from the shell, which it perfectly encloses, folding up at the sides, and meeting at the top, the joining being scarcely perceptible, and the whole surface fitting so tightly to the shell, that the little ribbings are seen distinctly through it. It is curious to observe the act of respiration, and all the associated phenomena of this wonderful little animal. The foot is pale orange, the mantle delicate olive, spotted with black and studded with protruding glands of yellow. It is, in short, when in a state of activity, a most curious and beautiful creature, of whose appearance and habits thousands, who only know and admire the deserted shell, can have no idea.

The bivalves, of which all are aquainted with at least one kind—the delicious edible Oyster—offer many animals suited to Aquaria. The curious Razor-shell, but for its habit of burrowing, would form a very curious object; and the Cockles, from

the rich colour of their beautiful fringes, when the shells are partially opened for feeding and breathing, are very beautiful objects.

The means of movement of the common Scallop, or Cockle, and other bivalves, by means of a single fleshy "foot," have been described in speaking of Molluscs in general; but the spinous Cockles, *Cordium aculeatum* and *C. tubercutum*, have been termed the aristocracy of the Scallop tribe. The valves of the largest open three-quarters of an inch, and the visible portion of the spongy-looking fleshy mantle is of a pellucid orange colour; at the end is protruded a double tube, thick and short, enveloped in a fringe of cirrhi or tentacles. The foot, which has been compared to a tongue, is smooth, glossy, and semi-transparent, like scarlet cornelian, and enables the creature to move about with great activity in an Aquarium; some that were sent, by the Rev. C. Kingsley, to Mr. Gosse, having startled that gentleman by the noise they were creating among the pebbles and other objects of his tank, by their rapid movements.

Many other kinds of shells might be mentioned if space permitted, but I must content myself with mentioning, *en passant*, the polished *Donax*, which, when the animal displays itself, exhibiting its bright

yellow colouring, with its curious stripes and gay pink fringes, would form a real ornament to the drawing-room sea; and just hinting at the introduction of a specimen of the *Tritonia Hombergi*, remarkable for a power of producing an audible sound like the click of a steel wire.

The pretty little bivalve, the *Lima hians*, also forms a very attractive addition to the Aquarium, especially in motion, when its long orange fringes form a train or tail like that of a fiery comet, as Dr. Landsborough has observed, as it glides along, propelled by the discharge of a jet of water, the mechanism for the propulsion of which forms its swimming apparatus.

CHAPTER VII.

THE ASCIDIANS, BARNACLES, SEA-CUCUMBERS, NAKED MOLLUSCS, SEA-WORMS, ETC.

A GROUP of *Ascidians* forms a very curious object for the Aquarium, their forms being singular, and sometimes delicate as a transparent egg-shell. The group delineated in Plate VII. will convey some idea of the general appearance of these creatures, whose habitations might be taken for a store of fairy pitchers, placed snugly in their submarine china-closet for extra safety, and partially covered with sea-weed as a further means of concealment. There are above fifty native species, varying greatly in appearance. They may be found at the extreme verge of low water, many having the aspect of pellucid bags, formed of a substance between jelly and leather; while others present a far more robust and rugged appearance, both in form and texture. Some are very dingy in colour, but a few species—more rarely found—are very attractive, and sometimes brilliant, in their hues.

The Barnacles must not be omitted in furnishing an Aquarium, nor the fable connected with the

Plate X.

1. Actinia crassicornis.

2. A group of Serpula contortuplicata.

Common Barnacle (*Pentelasmis anatifera*), in which it is affirmed that the Barnacle Geese were their offspring. Our old naturalist Gerard not only gives a detailed account of the transformation by which this wonder of the good old times was accomplished, but positively illustrates his description with an engraving, in which the metamorphosis is seen in progress.

The tube-like cells of the *Serpulæ* have some resemblance to the cells of the Common Barnacle, but that of the solitary Serpula, *Serpula tubularia*, is much taller, often rising a foot from the substance it adheres to. The fan-like feathers forming the feeding, and, perhaps, also the breathing apparatus, of *Serpula contortuplicata*, are exceedingly rich in colour, as is also the member which acts as a "cork" to the tube when the feather-like tentacles are withdrawn, and which is familiarly termed the "stopper;" for when, on alarm, the feathers are suddenly drawn in, the "stopper" immediately follows, shutting up the opening of the tube in a very perfect manner. This organ is often of a rich orange, and the feathers a brilliant scarlet, though they are sometimes pale, or nearly white, as shown in Plate X. These fan-like organs, termed feathers, appear to act as breathing organs, by separating the oxygen from

the currents of water which pass between their fibres. The *Sabella*, an allied tribe, forms its tube of mud; while that of the *Serpula* is always of hard shell. The golden-combed worm, *Amphitrite auricoma*, another singular creature of this class, may be best alluded to in this place. Just below the cork-like head, when it leaves its tubular shell, are the scarlet gills, slightly resembling those of fishes, and across the head the golden comb-like appendage is expanded, from which it derives its popular name. When the animal retires within its tube, the upper part of the head has, like the *Serpulæ*, all the appearance of a cork or small stopper. This creature is one of the most curious of its class.

The *Balani*, or Acorn-shells, which are generally parasitic, fixing themselves to the shell of the Whelk or some other univalve, spread their crimson tentacles when seeking food exactly in the manner of the *Serpulæ*, the feathery filaments forming a kind of living casting-net, as it has been observed, in which the minute *Annelid* or *Infusory* is entangled and devoured. Two *Balani* are represented in Plate VII. on the shell of a common Whelk.

The *Holothuriadæ*, or Sea-Cucumbers, are very singular creatures; their form, as it floats in the waters, exhibiting as good a miniature representa-

tion of a small pickled Gherkin as can be conceived, except in colour, the shells or cases of these animals being generally white. One of the species, *Hyalina*, has a case which seems formed of crisp rice-paper, and is covered with spines of the the same colour and texture. The tentacula, or breathing apparatus, eight in number, are curiously branched, and, when expanded, have the appearance of a skeleton flower, of which the figure in Plate IX. will convey a tolerable idea. The functions of this flower-like set of organs are probably the same as those of the *Nudibranch* class of *Molluscs*, which, though generally considered as being a breathing apparatus, are, probably, at the same time food-collecting organs, as all the creatures thus furnished are liquid feeders.

Thyone papillosa, one species of Sea-Cucumber, has ten branches to this set of organs, which it seldom displays when in captivity; but a little gentle motion artificially imparted to the water, as suggested in another place, would probably produce the kind of excitement requisite for their expansion, as the introduction of fresh water to the tank seldom fails to produce this effect for a time. When irritated, these creatures have the capacity of committing self-destruction in a most determined and complete man-

ner, by expectorating the whole of the intestines and leaving their case or shell bare and empty. But Sir J. Dalzell has observed that the shell thus deprived of its living inmate, must be much more intimately connected with its life and organization than the shells of the Molluscs; for after a considerable lapse of time, he observed that the rejected parts have been renewed by gradual growth. The introduction of a single drop of fresh water will at once drive the creature to this summary mode of putting an end to the inconvenience.

OF THE NAKED OR SHELL-LESS MOLLUSCS.

The Sea-Lemon, *Doris tuberculata*, is one of the most attractive. It derives its popular name from its peculiar form, which is like that of half a Lemon cut longitudinally. It is generally of a yellow tone of colour also, which greatly adds to the fancied resemblance. It has its breathing apparatus exposed externally, like other Nudibranchs, spreading over the mantle, near the head, in a flower-like shape; and, as it moves slowly round and round the Aquarium, forms a very singular object.

The *Doris pilosa* is a pretty white species of the same order; and the little black shining Nudibranch, *Runcina Hancoci*, is a pretty and interesting creature.

But the handsomest of the Nudibranch or naked-gilled tribe, as the term might be Englished, is the *Eolis corronata*, which forms certainly a splendid ornament to the Aquarium. Its general colour is a pellucid indistinct tone, of pinkish hue, the papillæ or branchiæ are in clusters, and the central canal is of a rich crimson. Different parts of the surface reflect the brightest metallic colours, and the whole creature has a very gem-like appearance. In captivity it is very active. Another species of *Eolis* has the power of making a singular clicking noise, like the *Tritonia*.

The *Aplysiæ*, or Sea-Hares, have been unenviably celebrated among their congeners as containing a virulent poison. The species common in the Mediterranean, *A. Leporinæ*, furnished the venom with which the infamous Locasta destroyed the enemies of Nero; and with which she eventually prepared, at the tyrant's request, a draught for himself, but which he had not the courage to swallow. The British species, *A. hybrida*, might probably be kept in confinement.

Many of the Sea-Worms are very beautiful. The *Nereis bilineata* is very brilliant, with its crimson body brightly marked by two white longitudinal stripes.

The *Phyllodoce* are a class of Sea-Worms, somewhat resembling the land Centipede, which form curious objects of observation when they are in search of food. Instead of spreading a set of tentacles, like some of the Zoöphytes and Molluscs previously described, they have the faculty of turning the cavity which forms the stomach inside out, like a stocking, the inverted organ protruding from its mouth to a considerable distance, which, when it becomes sufficiently covered with the minute Infusoriæ which form its food, is drawn in, assuming gradually its natural position, where it remains till the nutriment so introduced has been absorbed, when the operation is repeated.

The Sea-Mouse, one of the largest and commonest of our marine worms, is of a flattened and somewhat oval form, pointed at each end, its general colour being pale brown. The clothing of silky hairs, however, with which it is invested, is so splendid, glittering in iridescent colours like the plumage of a humming-bird, that Lamark has appropriately named it *Halithea*, or Sea-Goddess—Linnæus having previously given it the name of *Aphrodite*, the Marine Venus. When, indeed, it receives the rays of light, and reflects them from the depths of the sea,

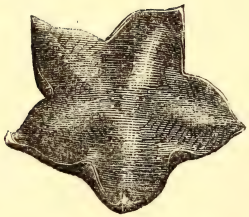
rich with prismatic hues, the effect has been compared in splendour to that of the peacock's tail when outspread in the sunshine. When in the Aquarium it crawls restlessly to and fro, as though anxious to exhibit its splendours in every possible point of view; the metallic tinges, changing with every position, being most magnificent by candle-light, when red and orange hues predominate, while by day-light pearly greens and blues are most frequent.

The bodies of many of the *Euricidæ* and *Nereidæ* exhibit changing colours of similar character, though less splendid; but many of them possess an opal-like tenderness and delicacy almost equally attractive.

The little Sea-Slug, *Ægines punctiluceus*, is a brilliant little creature, well worthy the trouble of being permanently established in our Aquaria. Its general colour is pale reddish-brown; but, with the aid of a moderate lens, it exhibits a number of small black tubercles, in the centre of each of which is a speck of resplendent blue or green, forming a succession of gem-like ornaments that have been compared, by enthusiastic naturalists, to sapphires and emeralds; but, without exaggeration, the jewelry of this little creature may be said to surpass that

of the Diamond Beetle, notwithstanding his superior reputation.

A few *Chitons*—a sort of Sea Wood-Louse—would do well in a tank; and a specimen of *Gastrophæna modolina* is said to have thriven well during many months.



CHAPTER VIII.

THE FISH AND CRUSTACEANS OF THE AQUARIUM.

A MARINE Aquarium may be rendered very interesting without the introduction of fish, and as their presence requires that the water should be once each day aerated by means of additional water, introduced by the syringe or by a drip, continuing for some time from another vessel, many may prefer the lovely Sea-Weeds, curious Zoöphytes, and beautiful Molluscs, alone; as, if the balance between the amount of animal and vegetable life be felicitously balanced, and the natural scavengers, in the shape of Periwinkles and other Sea-Snails, for the consumption of decaying vegetable matter, and a few Prawns to perform a similar office for perishing *Infusoriæ*, or any other animal matter, be properly supplied—the tank may remain for a long time undisturbed, the supply of oxygen being ample for the lower classes of animal life alluded to. The beautiful *Actiniæ*, indeed, will exist in apparent health for a considerable time in water in which no vegetable growth has been introduced. Mr. Gosse describes

instances in which the water in glass Aquaria, containing Sea-Anemonies, has remained perfectly pure for more than a year.

The addition of fish, however, undoubtedly enlivens the general aspect of an Aquarium very considerably; and many may not grudge the task of daily aerating the water, in order to enjoy the cheerful spectacle of their agreeable and ever-active movements. One or two young Flounders, very small, and the young of other species of flat fish, add much interest to an Aquarium, in consequence of their mode of swimming being so different to that of the class of fishes with whose movements the eye is more familiar.

Among the fish mentioned by the most experienced in the keeping of Sea Aquaria as best suited to that purpose, the first is the pretty little Tansy, *Blennius pholis*, with its bright scarlet eyes, and the many changing hues of its body. This little fellow will live and flourish in a tank with a poorer supply of oxygen than any other fish yet tried.

The fifteen-spined Stickleback, *Gasterosteus spinachia*, does well, and is very cheerful and brisk in his movements. Three or four would be an improvement to any tank.

Young of the gray Mullet, too, do well; for

if the supply of oxygen be rather inadequate, they are observed to put their heads partly above the surface of the water, and obtain an artificial supply in that surreptitious manner. The black Goby, *Gobius niger*, has also been tried with success; but his voracious character—devouring without scruple even his own congeners—renders him on the whole not a very desirable tenant; and yet it is a fine sight to see the little warrior turn black when he seizes his prey, his turquois-coloured eyes dilating with fury.

Several other kinds are mentioned, in a previous page, in the list of animals placed by Mr. Gosse in his first experimental Aquarium.

The Pogge, *Aspidophorus cataphractus*, is a singularly formed fish that might be added by way of experiment. The plate-armour in which his body is clothed runs in regular longitudinal lines, showing eight sharp ridges, running from head to tail, that have a singular and unfish-like appearance. In confinement, however, he does not display himself to advantage, generally lying near the bottom of the Aquarium.

The beautiful crimson maculations of the Ancient Wrasse, *Labrus maculatus*, render him a very desirable tenant; but his size—small specimens being

eight or nine inches long—causes him to be inconvenient; and, moreover, he his difficult to manage, and would probably require altogether a special treatment. One of the smaller Wrasses, however, *Crenilabrus cornubicus*, is a desirable guest; his minute size, and varying and often gay colours, rendering him very attractive. He is an active and eager searcher for food, but never takes any loosely floating object, only darting at and detaching such atoms as are attached to the different species of Algæ.

The Pipe-Fish, *Syngnathus acus*, is interesting in the tank, and also the two-spotted sucker, *Lepidogaster bimaculatus*, a prettily coloured and curious little fish, which has the faculty of attaching itself to the side of the tank, or any other hard flat surface, by means of two singularly-formed ventral fins, which act like the leather suckers by means of which boys enjoy the sport of lifting heavy stones at the end of a string. The spawn of this fish is like tiny amber beads, and is attached to shells and other substances.

Among the Crustacea fitted for an Aquarium, the common Prawn, *Palæmon serratus*, holds the first rank. In the first place, his cleansing properties, in devouring all decaying animal matter, are most im-

portant. But not less interesting are his graceful movements: Now, he steals stealthily over the pebbles or the fronds of the Algæ, with his long, slender, hair-like horns in gentle motion, with all the seeming wariness of a cat (the resemblance being increased by candle-light by the fiery glare of the eye); next, leaving his walking apparatus, or legs, inactive, he uses only the swimming members, which are larger and flatter, and bordered with a compact fringe; agitating these instruments with beautiful regularity, he rises in the water with graceful ease (see Plate VI.), his semi-transparent body, as he rises, giving to his appearance a strange and somewhat apparition-like aspect, which has caused him to be compared to a marine spectre.

The Prawn takes its food with its *second* feet, two-fingered hands or claws, and carries it to its mouth. The hands of the *first* pair of legs are only rudimental in appearance, but are precisely fitted to their special purpose. They are his cleansing apparatus; and it is most interesting to watch the operations of his toilet when he uses these fringes as brushes, with which he cleanses his whole person most thoroughly, being almost unmerciful in the amount of severe scrubbing to which he subjects himself.

An allied species, *P. squilla*, is scarcely distinguishable from *P. serratus;* but the handsome scarlet-striped Prawn, *Pardulus annuticornis*, about the size of a Shrimp, is quite distinct, and would make a valuable addition to the collection. The Lobster Prawn, also, *Athanas nilescens*, has likewise been tried.

Some kinds of Crabs may be admitted, but not many; for several are extremely voracious, and would soon clear off all the naked Zoöphytes and most of the Molluscs.

The Climbing Crab, *Eurynome aspera*, is interesting in a tank from his habits. His climbing is as graceful and skilful as that of a monkey, and when he has succeeded in perching himself upon the highest object in the tank, he forms a picturesque object.

Crabs, like Prawns, are sea-scavengers, and the kinds that do not attack living creatures as well as dead are consequently useful in a tank. The great Fiddler Crab, *Portunus puber*, is remarkably handsome. He is clothed, in part, with a velvety brown fur, and the bare places of his shell are of a shining black. His eyes are marked with scarlet, and there are a few touches of bright blue about the head. If introduced, his proceedings should be carefully watched.

There should certainly be a specimen of the Hermit Crab in a Whelk-shell; and the Cleanser Crab, *Portunus depurator*, has been tried, but these active and greedy Sea-Spiders must be closely looked after.

It remains to speak of the Star-Fish tribe, which affords some of the most beautiful and easily managed subjects for the Aquarium.

In the centre of the lower part of Plate VI. are a large and a small specimen of the beautiful scarlet species, *Geniaster equestres*; just above, to the right, the graceful pink *Cribella oculata;* further to the right, *Asteria gibbosa;* and immediately above the *Cribella*, the thin, leathery species, the bird's foot Sea-Star, *Palmipes membranaceus*. All these species are small, easily managed, and especially suited to the Aquarium; as is also the finely-marked and long-rayed *Ophicoma rosula*, his deep scarlet, with bright black marks, and his slender limbs or rays, rendering him a conspicuous object. These Star-Fish glide round the Aquarium, by the aid of their thousand sucker-like feet, in a very interesting manner.

All the true Star-Fishes, the *Asteriæ*, have the body divided into rays, like a star, and are furnished with sucking feet, or *cirrhi*, which are tubular,

and filled with water. The internal structure of these creatures is very intricate and beautiful, and the skeleton of almost any kind offers the appearance of that of some exquisitely symmetrical flower. There are fourteen British species of Star-Fish, the finest being the Sun-Star, *Solaster papposa*, the disk, surrounded with twelve or thirteen rays, varying in colour from scarlet to deep purple, the rays being sometimes of a different colour.

The *Luidia fragilissima* is also a large kind, sometimes two feet across, which is peculiar to the British shores. It possesses the peculiar faculty of breaking itself into fragments when enraged or captured; and, in a work by the lamented Professor Forbes, there is a very graphic and facetious account of a specimen that escaped him in a very determined way by a suicide of this kind.

Stars of this class, having the power to dislocate their structure, are popularly known as brittle Stars. Some affect to consider this faculty not so very wonderful; but let such suppose for a moment some higher animal—a man, for instance—gifted with a capacity for exploding his trunk and limbs into moderately-sized fragments—into joints, as a butcher would say—at any slight provocation, and then the character of such a power would appear very suf-

Plate VI.

1. Edwardsia vestita.
2 & 3. Geniaster equestres.
4. Cribella oculata.
5. Asterina gibbosa.
6. Palmipes membranaceus.
7. Palæmon serratus.

ficiently extraordinary. It is possible that the fragments of the disruptured Star-Fish have the power, in each separate fragment, of renewing the absent portions, and that each portion thus becomes a perfect fish, the dissevered portions having been noticed to retain their vitality long after their separation. We know that the little Garden Lizard has the power of dislocating his tail without effort, and leaving it between the thumb and finger, when he is playfully caught by that appendage; and, also, that he has the power of renewing his caudal extremity within a very short period. It is thought, therefore, not impossible, reasoning by analogy, that the Star-Fish may possess powers of a similar kind, of a somewhat more extensive character.

The Amnion Star-Fish, called sometimes Five-fingered *(Asterias rubens)*, belongs to the division *Echinodermata*, that is, skinned like the Hedgehog.

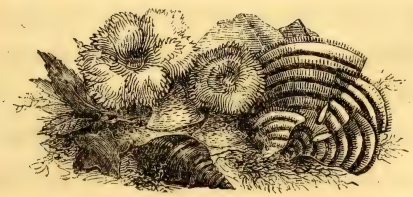
The Sea-Egg, Sea-Urchin, or Egg-Urchin, as it is sometimes called, belongs also to the *Echinodermata*, or Hedgehog-skinned class, and form interesting objects in the Aquarium; the flat species exhibiting much more evidently their close affinity to the Star-Fish tribe, than those of the more common spherical form.

To revert to other classes that occur to me as suitable objects for an Aquarium, I may mention the "Red-noses," as they are graphically termed (*Saxicava rugosa*), a colony of which, peeping out of their holes in the rock, would form a very striking object; and if a piece of their native rock could be detached sufficiently deep not to disturb them in the recesses of their tube-like burrows, their removal "*en bloque*" would not be difficult. When touched, the Red-nose squirts a stream of water at you in defiance, and darts back into his cavern. He is a small bivalve, having his inner or immediate home within two rough brown shells. The double-tubed proboscis with which he is furnished is extended, when in search of food, to the mouth of his cave, in which position the appearance of its ruddy terminus has given to this tribe the characteristic name of "Red-noses." How he contrives to bore a hole in the solid rock, with any of the soft pulpy members with which he is furnished, appears a mystery. Other Conchifers have, however, similar capabilities, their ingenuity not being confined to rocks, and their industry not being always harmless. Such, for instance, is that of the Teredo, or Shipworm, a species of which has long proved so inimical to the formation of a Russian fleet in the

Black Sea—the late war having, however, proved a far more serious impediment to the development of that portion of the Russian navy.

The Sea-Leaf, formed of twenty thousand or more cradles for young Polypes, is also a curious object. It is the Polyzoön, sometimes called the Hornwrack.

A few of the translucent Medusæ, in a young stage of their existence, might be procured and tried, though their transport would be difficult; and a group of creatures, of the genus *Zoöthamnium*, forming, as they do, an object like a little tree of glass, covered with trumpet-shaped bells, of the same crystalline aspect, each exhibiting its rotating circle of minute cilia in rapid motion within, would form a singular and beautiful complement to the wonders of the Aquarium, if its removal from its native depths, and its location in its new home, could be successfully managed.



CHAPTER IX.

CONCLUSION.

In conclusion, a few general remarks may be made, the observance of which will usually ensure success in the formation of an Aquarium. In the first place, if the vessel in which the Aquarium is to be established be home-made, care must be taken not to use any cement that has a disagreeable smell—which would be very soon fatal to creatures accustomed to the pure waters of the ocean. Scott's cement is said to be better than putty, for fixing in the glass to the columns at the angles.

If cement be used to fix the rock-work of the miniature marine landscape, let it be the best Portland cement, which, when dry, must be soaked by filling the vessel with water, and the water changed several times before the tank will be fit for use.

The best sand for the artificial beach, or bottom, is the Thames' sand, used by builders; but this must be washed several times, till the water runs off quite clear, before it is fit for use—any other kind of sand, if that cannot be procured, must be submitted to similar washings. Sea-water can

be procured by furnishing the steward or captain of any Thames steamer, or the guard of a railway in connection with the coast, with a clean barrel; the charge, in either case, for carriage and trouble, would not exceed two or three shillings.

The artificial salt water has been found sufficient for Zoöphytes, but not for fish and other of the higher class of marine animals, except for a certain given time.

The composition for artificial sea-water is as follows:—

Common salt	3½ oz.	
Epsom salts	¼ oz.	
Chloride of magnesium .	200 grs.	troy.
Chloride of potassium . .	40 grs.	troy.

To these are added four quarts of water, and when the salts are thoroughly dissolved, say on the following day, the liquid must be filtered through a sponge; it is then fit for use.

Care must be taken to observe whether, when the sun shines and the light is bright, the silvery bubbles of oxygen form upon the fronds of the marine vegetation; and if not, it is certain that the marine plants are not in a healthy state, and must be renewed.

Mr. Gosse gives the following final directions as

to the class of animals and plants that should be selected in preference for the experiments of beginners.

With regard to sea-weed, he observes, do not take Oar-weeds or Tangle; all the Fuci are of a slimy nature, which it is difficult to manage, and as their size is inconvenient, and they have but little beauty, their absence is not to be regretted.

Of animals, he says, take:—*Of Fish*—Blennies, Gobies, Wrasses. *Of Mollusca*—Aplysia, Periwinkle, Chitons, Scallops, and Burrowing Bivalves, such as Venus, Pullastra, &c. *Of Crustacea*—Eurynome, Portunus puber, Carcinus mænas, Ebalia, Corystes, the Paguri, Porcellana platycheles, and the Crangones, the Palæmones, that is, Shrimps and Prawns. *Of Annelids*—Pectenaria, the Sabellæ, and the Serpulæ. *Of Zoophytes*—the Madrepores, and *all* the Actiniæ.

Few will establish an Aquarium without deriving great mental improvement, and the enlargement of their circle of acquirement, in a direction highly calculated to develop some of the best and highest feelings of our nature. Even the scientific cannot fail greatly to enlarge their sphere of knowledge in this new, and almost untrodden, field of research. The entomologist, sighing that there are no new

Tiniæ to add to his already enormous list, no new Curculios with which to form another volume to the already portly series—these and other physiological Alexanders, weeping for new regions to subdue, may hail the Aquarium as a fertile source of further conquests; for, notwithstanding the numerous and curious discoveries of recent investigators, the depths of the ocean are as yet, comparatively speaking, one of the untrodden fields of science; and a glorious arena it presents—the Aquarium being one of the fairest channels for the detection of its myriads of yet hidden mysteries.

The marine Aquarium is, as yet, a plaything, a mere toy; but it is destined to become a far more important means of advancing science, and ministering to popular instruction, amusement, and wonder, than is yet dreamt of. It has yet to do for the ocean that which our menageries and vast gardens, devoted to the service of natural history, have done for the forests and mountains of the terrestrial portion of our planet.

We shall yet have tropical Aquaria, in which the temperature and qualities of the sea between the tropics will be so successfully imitated, that the glorious shells of those regions will be exhibited in living motion to our greedily-curious gaze; and fish

gleaming with unusual dyes—metallic azure, and silvery crimson—will dart and glide in our tropic-tempered tanks, as in their own tropic ocean, for our delight and gratification. We are now entitled to expect from science, that it shall exhibit to us the wonders of the tropic deeps, as it has shown us the glorious plumage and velvet-spotted furs of the denizens of its terrestrial forests.

This is, in fact, the only thing that remains for us to do, in making a fitting popular display of the wonders of Nature, in order that we may surpass the doings of the ancients in that field of popular instruction and gratification.

Even in the days of Cyrus, we learn from the graphic Xenophon and other sources, that every eastern satrap had his "paradises," in which the most curious animals of distant regions were preserved in a state of liberty, and in a manner suited to their natures, either for the sport of hunting or for the curious gratification of the eye.

The Romans, long before they had attained to the material wealth of the modern nations of Europe, had exhibited to the people of their capital all the noblest animals of Asia and Africa. Even the Giraffe and the Hippopotamus were familiar forms to the Roman populace; while, with the

great modern nations of the west, the sight of these wonderful creatures is but quite a recent gratification. It only remained to the ancients to have exhibited a Titanic Aquarium, to render our triumph over their labours in the field of popular natural history impossible. Had but a Roman Warrington or Gosse developed the germ of such an idea, and an Osler existed to furnish the glass—the Pompey, or Cæsar, or Crassus, would not have been wanting to feast the eyes, both of patrician and plebeian Rome, with an Aquarium measuring hundreds of feet in length, in which the monsters of the deep would have been exhibited in deadly conflict, and human divers, armed with net and trident, like the retiariæ of their gladiatorial combats, would have encountered, beneath the waters, the Shark, the Whale, or the Torpedo, to the shouts of crowded circuses, the centre of which would have been a glass-walled ocean.

But a gigantic Aquarium is, fortunately, a feat that yet remains for modern science to achieve, and which it will doubtless accomplish. The day will arrive when we shall see the living Behemoth—the Titan of the deep—rolling majestic in waves of his native element, perhaps pursued by his cruel enemy the Sword-Fish, or harried by a shoal of Her-

rings, graphically exemplifying to a London crowd the origin of Yarmouth bloaters. Or we may see the dreaded Shark float round and round the vast glass prison seeking his prey, and the Shark-hunter of the south seas may be imported to exhibit his skill in a bloodless conflict—mocking the attempts of the sea monster to seize him, as the Spanish matador plays long with the infuriated bull; but without necessitating the same catastrophe to the animal, defenceless against the specially-trained skill of his human antagonist. We have already had our crystal palaces, covering their acres, and filled with objects of art and wealth from every quarter of the globe; it is not impossible, therefore, that we may have crystal-walled seas, in which aquatic menageries will form the last new object of fashion and wonder.

For the present, however, the Aquarium is, as I have said, but a toy, yet one full of pleasant instruction; and it doubtless contains the germs of a development, the precise direction of which it is at present difficult to guess.

THE END.

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